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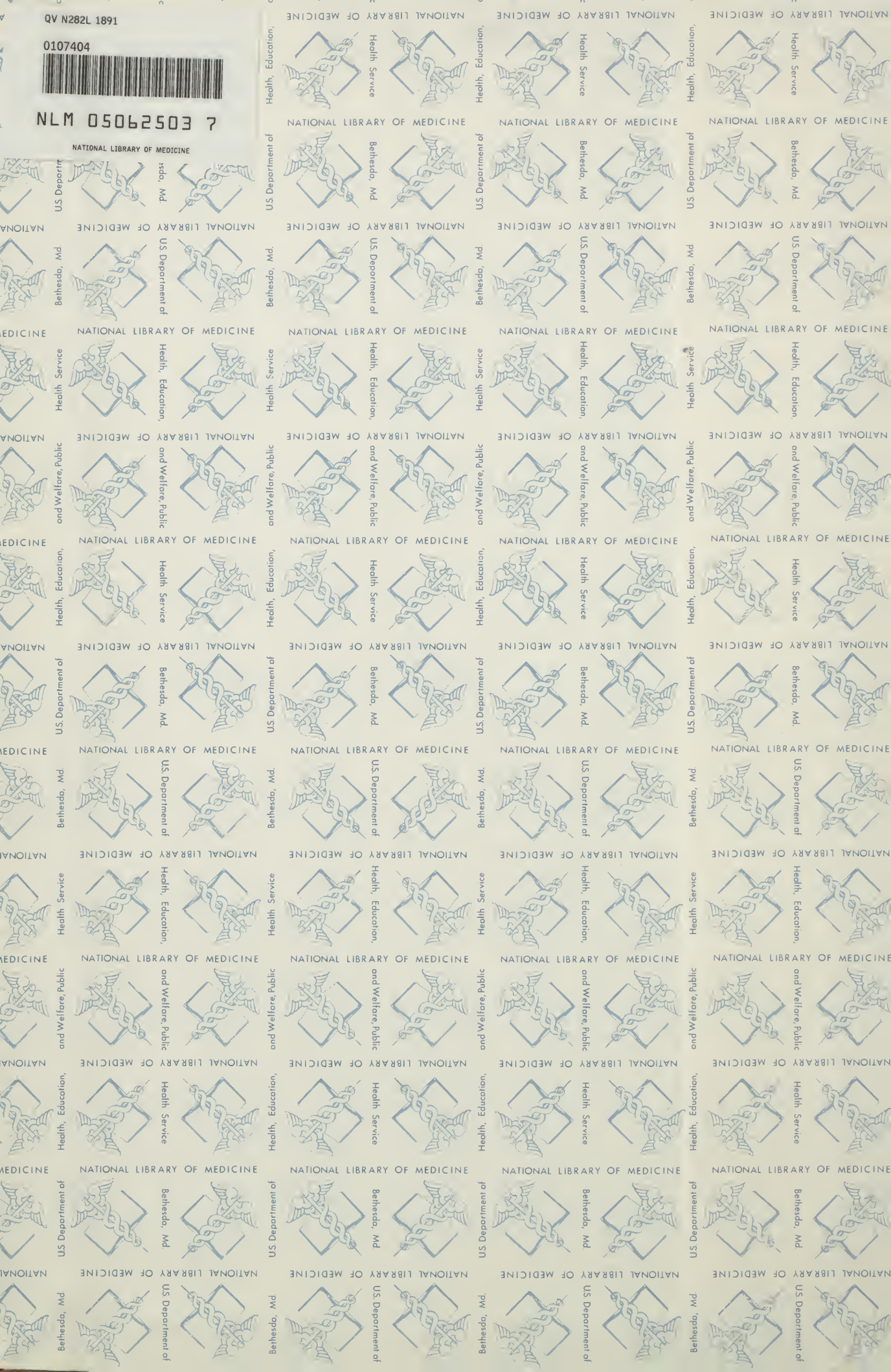

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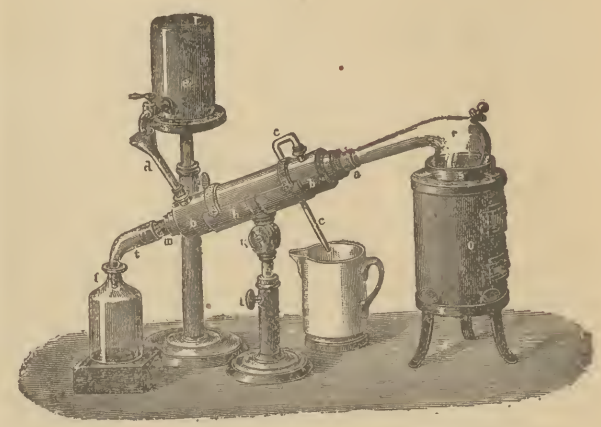
NATIONAL INSTITUTE OF PHARMACY.

Lectures Semi-Monthly. Subscriptions, $15 per Annum.

C. S. HALLBERG, Ph. G., Director.

TERM IN PHARMACY

LECTURE I.



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Introduction.

The design of these lectures is to present a course of instruction in pharmacy and its collateral branches to those actively engaged in the preparation and dispensing of drugs and medicines.

It is believed that this object may be best accomplished by presenting the instruction in the most simple manner possible. To make it thorough and comprehensive, it should begin at the foundation, and then gradually, by easy steps, advance to the more difficult problems and branches of the sciences contributing to the intelligent practice of the art of pharmacy.

The lectures are therefore arranged with the view of being as easily understood as the subjects treated will admit, while at the same time it is sought to make the information sufficiently complete to do the topics justice. As previously announced, the information embraced in the lectures will be in as condensed a form as practicable, without in the least detracting from perspicuity, or omitting anything, a knowledge of which involves important facts or observations. References will be made throughout the lectures to such standard text-books as are recommended for the course, whenever it is thought desirable further to elucidate a topic, and when such additional information would prove too voluminous for these pages, or not be indispensable to a proper understanding of the subject.

In this connection it will be found important to note that, while there has been no rigid discrimination in the selection of books for reference—those usually found in the average pharmacy having been chosen—yet the use of the old Pharmacopœias and the older editions of Dispensatories based upon these are neither appropriate or reliable.

In common with all institutions for teaching pharmacy, journals devoted to pharmaceutical literature, standards for examination adopted by State Boards, in harmony with the progress of science, the instruction in this course of lectures will be based upon the standards of strength and purity adopted for the preparations of the U. S. Pharmacopœia, 1880.

While these standards will be maintained throughout the series, the form of the Pharmacopœia, that is, the parts by weight or percentage system, will not always be followed or endorsed in these lectures. This system, as adopted throughout in the U. S. P., 1880, belongs to the decimal, centesimal or so-called percentage system, which, while in perfect harmony with the decimal or metric system of weights, is quite inappropriate for use in this country, where the old English pound and quarter fractions are almost universal.

How to escape the complications arising from the adoption of this system as a standard in practical pharmacy, where measures and avoirdupois and troy weights are, and for some time to come no doubt will continue to be, used, will be given due attention in these lectures.

Explanations, supplemented by simple examples showing how the standards of strength and purity of preparations may be maintained by the application of familiar and easy methods—the use of pint and pound—thus complying with the spirit of the U. S. P., 1880, will receive careful attention.

In studying these lectures it is recommended that, whenever admissible, the plan originally outlined in the Announcement be followed. The pages comprising a lecture are so divided that each page treating a subdivision of a general subject may easily be detached and hung up near the prescription counter, or some equally convenient location, by some simple fastening device, where the pages may be consulted when a leisure hour will permit. By forming a resolution to study and master one subdivision daily, making it a rule to replace the page each night and to place the succeeding one in a position to be accessible next morning, the lecture may easily be finished within the time allotted, several days remaining each month for answering the questions appended.

These questions, accompanying each lecture except Lecture I, will cover the subjects treated in each previous lecture; and it is required of students that the questions be answered and promptly returned by mail before a new lecture is sent. (See "Important Notice," Lecture II.)

It is designed that each lecture be mastered before the corresponding questions are answered, and that therefore no references be made to the lectures for answers. It is needless to add that strict conformity to this rule will greatly inure to the advantage of the student, both because of the closer study required and more thorough discipline received, and because such dependence would inevitably stamp itself on the replies as written, and proportionately impair the student's record.

A certificate of merit or diploma will at the close of the course be issued to students whose final examination shall prove satisfactory; while it is believed this certificate will justly be a source of gratification and pride, and serve as a memento of pleasant hours and profitable study, it will of course possess no legal significance, though there can be little doubt, that thorough conscientious work during the course would, with the requisite experience, result in ample qualification for a successful Board of Pharmacy examination.

It is believed that compliance with the above suggestions will facilitate study and assure the utmost information of practical and permanent value. While it is not intended to formulate any arbitrary rules of possibly impracticable application by every student, it is at the same time thought desirable to make such suggestions as involve the usefulness and prospective value of the course. The method of instruction embodied in these lectures, differing as it does essentially from that obtained by the simple study of books, the best results will attend adherence to the spirit of the plan as here outlined.

Pharmacy.

The generic term Pharmacy includes the several *sciences* which contribute to the knowledge of drugs and medicines, and the various *arts* requisite to the practical application of such sciences in the preparation of medicine. Pharmacy, therefore, being a combination of science and art, may be divided into two comprehensive departments, *theoretical* and *practical.*

THEORETICAL PHARMACY.

Theoretical Pharmacy embraces nearly all the natural sciences, for the reason that all the different kingdoms of nature, animal, vegetable and mineral, contribute substances used in medicine, and hence the three general sciences, zoölogy, botany and mineralogy.

All matter belongs to one of these three great divisions, and is accordingly classified and described as to its physical characteristics, or sensible properties, in the corresponding sciences.

When, however, we enquire into the laws which govern the character or properties of substances, as related simply to the changes in such bodies, or to the origin or causes of such changes, when these do not affect the identity or sensible properties or constitution of the matter, such science is termed *physics.*

When these changes are such as to involve the loss or transformation of one substance into another or into different substances, it is termed *chemistry.*

Examples of these two natural forces, respectively, may be illustrated by familiar phenomena: A piece of lime broken into fragments by force, the movement of a small piece of iron toward a magnet, or that of a stone back to the earth from which it had been thrown, the floating of a piece of wood on water, and a thousand and one similar incidents of constant occurrence—all these are dependent upon or explained by physical laws, the science of which is termed *physics.*

On the other hand, when these same substances are treated so as to change their composition, as, for example, when a piece of well-burnt lime, dampened with water, becomes heated, is transformed into calcium hydrate (slakes), and falls into powder, which, absorbing carbonic acid from the atmosphere, is converted into calcium carbonate or chalk; or when a piece of iron exposed to dampness rusts, forming oxide of iron; or, when sugar, through fermentation, is decomposed into alcohol and carbonic acid; in short, whenever the change affects not only the physical characteristics, but also the elementary composition of a substance, it is called a chemical change, and the science contributing to a knowledge thereof *chemistry.*

The sciences named, we may say, therefore, constitute *theoretical pharmacy*, that is, they are the basis of pharmaceutical science. From this, however, it must not be presumed that a thorough knowledge of all is essential to a knowledge of pharmacy; while such knowledge would be very desirable, an intimate knowledge of each would be entirely too comprehensive, in fact, quite impossible to attain by any one engaged in active business. It is nevertheless desirable that, in pursuing studies in pharmacy, a limited knowledge of these should be had in a general sense; zoölogy and physical laws will not come under our province, except as they may be necessary to elucidate a special subject embraced in these lectures.

The fundamental principles of matter should above all be mastered to enable the student to understand more readily and thoroughly the various operations and processes involved in pharmacy, and it is recommended that, conjointly with the first lectures, the first chapters in an elementary chemistry or in some work on physics be carefully reviewed.

The vegetable kingdom furnishes the largest number of substances used in medicine, hence its importance in the study of pharmacy.

Botany (which will be treated in the second term) is the science in which all plant or vegetable life and its parts are classified and described.

Mineralogy is the science of minerals, and in connection with physics, has, we may say, established that science, which perhaps is the most important of all in the study of pharmacy, namely, chemistry. While this subject is reserved for the second term, we shall make such reference thereto during the first term as may be deemed essential.

Materia Medica (medicinal matter). This term is applied to all materials or substances used in medicine, frequently only to such derived from the vegetable and animal kingdoms, when it is termed "organic," and also to the science of crude drugs.

Pharmacology is the science of the uses and properties of remedies; hence in one sense, the science of medicine.

Pharmacognosy is the science of crude drugs, organic and inorganic, their identification and valuation. The term is seldom used.

Pharmaceutical is a term applied to any science or attribute having relation to pharmacy, *e. g.*, pharmaceutical botany, phar. chemistry, phar. preparations, phar. literature, etc.

PRACTICAL PHARMACY.

Practical Pharmacy is a still more comprehensive division than theoretical, since it embraces the collection, preparation, preservation and dispensing of medicines, and may be defined as the practical application of the theoretical sciences, or the *art* of pharmacy.

The subjects embraced in the first three lectures, viz., Metrology, Heat and Solution, are, it may be said, the ground work of pharmacy. Upon these rest all the operations involved in pharmaceutical practice, and a thorough understanding of these becomes, therefore, absolutely essential. While one whole lecture has been devoted to each of these subjects, the student is recommended to still further pursue their study in some elementary work on physics or chemistry.

Pharmacy Laws.

Though the pharmacy acts in force in the various states differ more or less in structure and detail, they all have a common purpose, viz., to confine the practice of pharmacy to such persons only as may appear qualified to perform their duties intelligently, and with safety to the public.

Pharmacy laws not "class legislation."

The impression is prevalent that pharmacy laws are designed especially for the benefit of persons engaged in the drug business. No law of the kind was ever in justice enacted upon this theory. Law-making bodies have no right to legislate directly in the interest of any special class or profession of men. Representing the people in general, they are bound to consult only the interests of the people, and it is this principle alone which should dictate the provisions of all pharmacy acts, and which should exclude any clause not required for the protection of the public. For druggists to ask legislation upon any other principle would be a species of pure mendicancy, to which a legislature could not yield without self-stultification and a betrayal of its trust.

Legislation protective of the public.

That pharmacy laws are essential to the public health and safety admits of no denial. That incompetent persons should not be permitted to defeat the purpose of intelligent prescribing, and bring death and sorrow to anxious homes, is self-evident; that every precaution should be taken to insure the utmost skill, knowledge, experience and conscientiousness in these questions so closely related to the dearest associations of earth, so vital to the preservation of homes, and to the happiness of the people, will be universally conceded. Disease too often conquers, despite the resistance of medical and pharmaceutical science; but who will say how many deaths, ascribed every day to disease, may not be due in fact to inexperience or ignorance in our pharmacies? Education at the dispensing desk is not less important than at the bed-side. One should faithfully supplement the other, and a sacred privilege of the former is to correct, when need be, any palpable error of the physician, committed amid the confusing scenes frequently occurring in the sick-room.

But, we are told, if special laws are necessary in the case of drug stores, why not in the case of grocery stores and other sources of food supplies? Is not food as important as medicine, and is not the public able to care for itself, and to avoid unreliable places? We answer that, as regards the ability of the public to discriminate, there is little or no analogy between drug and food stores. A little experience by a person of average intelligence will usually assure a tolerably accurate judgment of qualities of food, and if an error be made, it is very rarely of immediate and critical consequence. But even the more intelligent drug-store patron, on the other hand, may be presumed to know absolutely nothing respecting the nature, qualities, doses or compounding of drugs, and, if an error be made, it is too often disastrous if not fatal in its results. While a good law against adulterations is therefore usually sufficient to protect the public against unwholesome food, nothing short of a law which shall reach the *dealers in drugs*, which shall exclude the incompetent, and assure all possible skill and trustworthiness in medical dispensing, can be regarded as adequate.

Importance of legislation to pharmacy.

Because pharmacy laws are not framed in the interests of pharmacists, it must not be presumed, however, that they do not benefit the profession. The protection, though incidental to that designed to be given to the public, is none the less valuable and important. The discrimination against incompetency and quackery demanded by the public welfare is inevitably associated with discrimination in favor of the educated, the experienced and competent. It is for this reason that every reputable pharmacist has a special personal interest in the enactment and maintenance of pharmacy laws. While they accord to his profession a legal status, honor it with distinctive recognition among the learned sciences, purify it by rejecting elements which otherwise would tend to degrade and disgrace, elevate it to a rank of dignity, strengthen it with possibilities for the more rapid development of its literature, for the growth of its educational institutions, and for substantial advancement in efficiency—while accomplishing these great results, these laws also confer direct business advantages by restricting the number of druggists, reducing competition, and thus, by dividing the trade into fewer parts, assure to each more nearly adequate remuneration. We repeat that, while the public has a general interest in pharmacy laws in times of sickness, the educated pharmacist has a special professional and mercantile interest in their maintenance at all times.

The structure of pharmacy laws.

The precise character of an ideal pharmacy law we shall not attempt to describe. This species of legislation is still in its infancy, and years of experience will be required to develop it, and to adjust it to American institutions. Certain fundamental provisions are, however, indispensable to a just and efficient law:

(1) Its scope should include, for reasons previously stated, only such departments of the pharmacy as require the exercise of special professional qualifications. For this reason, "patent medicines," and certain "domestic remedies," the vending of which requires no special scientific knowledge, may properly be subject to less stringent regulations.

(2) All druggists in business when a new law takes effect must, for constitutional and prudential reasons, be permitted to continue in practice, and all clerks of sufficient experience be permitted to continue in their duties.

Pharmacy Laws.

(3) The proper administration of the law requires a Board of Pharmacy composed of pharmacists only.

(4) After the law takes effect, all persons desiring to engage in the practice of pharmacy should be required to pass a satisfactory examination before the Board. As the test of competency should obviously be uniform, and all candidates be accorded equal opportunities, no exception whatever to this rule can be regarded as just or permanently expedient.

(5) In the absence of a legislative appropriation, it is clearly good policy for the persons most interested in maintaining the law — the druggists — to provide the requisite revenue. The payment of a small fee at stated intervals by all pharmacists registered appears to be the most feasible method for the purpose.

(6) The penalties for violation should be sufficiently severe to insure respect, and sufficiently certain to insure prompt conviction. To insure conviction the Board of Pharmacy should be charged with the duty of causing prosecutions.

(7) As the avowed purpose of the act is simply to restrict the practice of pharmacy to competent persons, it is sufficient to require that the actual dispensers in a store be registered, regardless of whether or not the proprietor be registered, though, in order to insure conformity to the spirit of the law, the proprietor should be held responsible for failure to keep a registered pharmacist in charge.

The constitutionality of the principle embodied in pharmaceutical legislation has recently been affirmed by the Iowa Supreme Court, and prosecutions under the various state laws, in the absence of verbal defects, have quite invariably been successful. Supported by the people, the courts and the profession, their foundations are deep, firm, and, we may assume, permanent.

State pharmacy laws are in force in the following states: Alabama, Colorado, Connecticut, Georgia, Illinois, Iowa, Kansas, Kentucky, Maine, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, Pennsylvania, South Carolina, New Hampshire, New Jersey, New York, North Carolina, Ohio, West Virginia, Wisconsin, Dakota, and Wyoming Territory.

There is no reciprocity among State Boards of Pharmacy as regards certificates of registration. No State Board recognizes the certificate of any other. A pharmacist registered in one state has no advantages in another state over an unregistered person. While this frequently causes great inconvenience and even hardship to pharmacists desiring to change their location from one state to another, it seems unavoidable under existing conditions. The New York Board, for instance, cannot afford to abdicate its authority in that state by accepting certificates from Illinois or Michigan, which would practically give to the latter co-equal authority without possibly maintaining a co-equal standard of examinations. The only manner in which reciprocity can be properly brought about is, first, by making all laws practically uniform in their conditions for registrations; or, second, that all Boards agree upon a common standard for examinations. The first requisite appears to be a remote possibility, and the second has been attempted, but without success.

Board of Pharmacy Examinations.

It may be assumed that the standards adopted for examinations by State Boards of Pharmacy are designed with a view of determining whether or not the applicant be sufficiently competent to prepare and dispense drugs and medicines, and therefore qualified to conduct a pharmacy. As this can only be determined by an examination chiefly theoretical in character, it is obvious that practical experience in pharmacy alone, unless associated with information obtained by a systematic study, is not sufficient to insure success. While such examinations may be largely theoretical, they are nevertheless calculated to draw out information which is also practical; in fact, theory and practice are so interwoven and interdependent in pharmacy, that they are necessarily inseparable.

Although the various State Boards of Pharmacy have individual standards of examinations, they all have a common basis in the different branches, as follows:

Pharmacy.—Pharmaceutical preparations of the U. S. P.; their component parts or ingredients, mode of preparation, strength and doses; weights and measures; dispensing of prescriptions.

Chemistry.—The chemical compounds and preparations of the U. S. P.; their physical and chemical properties; specific gravity; percentage of anhydrous acid and degree of saturation; preparation and tests for the more simple compounds, such as calomel; enumeration and description, and sometimes distinction, of compounds from a certain metal, such as the chlorides of mercury; incompatibles; poisons; preparation of oxygen, chlorine, etc., involving elementary chemistry.

Materia Medica.—Latin titles for vegetable drugs, and name of natural order, with a brief description of their botanical and physical characteristics; name of active principles, their properties and doses.

Identification of Specimens:

Of crude drugs, such as cinchona, columbo, senna, taraxacum, etc.

Of chemicals, alum, borax, saltpeter; sulphates of iron, copper, zinc, etc.

Of pharmaceutical preparations, tinctures of opium and opium camph., syrups, glycerin, etc.

A verbal examination is added to the regular written examination, in cases where the Board deem it advisable to satisfy themselves as to the competency of the applicant.

The U. S. Pharmacopœia.

The first Pharmacopœia for the United States of America was published in 1820, in Boston, in both the English and Latin languages, according to a draft endorsed by a convention of representatives from the medical colleges and societies held in Washington, D. C., that year. Revised editions appeared successively in 1830 and 1840, when much assistance was rendered by the Boston, New York and Philadelphia colleges of pharmacy, especially by the last named. In this revision the Latin version was dropped, and the process of displacement or percolation introduced for the first time. The next revisions took place regularly every ten years, the colleges of pharmacy being more and more largely represented until the convention of 1880, when they virtually did all the work of revision and compilation, the representatives of medical asssociations and colleges merely confirming the work done by the pharmacists.

There are about twenty different pharmacopœias, that of the United States occupying undoubtedly in point of scientific arrangement, completeness and accuracy, a place second to none.

The United States Pharmacopœia, 1880, is now *official*, which means that it is at present, and until again revised will be, the *only* recognized standard for the *identification*, *strength* and *purity* of drugs and medicines in the United States. These requirements of the Pharmacopœia are therefore said to be *official*, *e. g.*, official strengths, tests, etc.; the method of preparation is likewise termed the *official* process.

Officinal is a term employed to designate drugs or preparations recognized in the Pharmacopœia, while remedies not recognized by the Pharmacopœia are termed *unofficinal*.

The terms *official* and *officinal* have been employed rather indiscriminately, but the distinction as above noted should not be overlooked.

The principal changes in the U. S. Pharmacopœia, 1880, over the U. S. P., 1870, are:

(1) An absolute alphabetical arrangement throughout, dispensing with the so-called "Secondary List."

(2) The adoption of a nomenclature to conform to the more recent progress of Botany and Chemistry. This involved the following changes:

(*a*) The officinal *Latin* titles of vegetable drugs to be the botanical *genus* (family) name of the plant, instead of the *species* name; as for example: Erythroxylon instead of Coca (from Erythroxylon Coca). There are many instances, however, where this change could not be made, *i. e.*, Artemisia absinthium, Aristolochia serpentaria, etc.

(*b*) The officinal *English* title to be the *scientific* (botanical) name in preference to the vernacular; as for example: Paullinia rather than Guarana (Paullinia sorbilis); Pilocarpus instead of Jaborandi (Pilocarpus pennatifolius); Podophyllum for Mandrake (Podophyllum peltatum), etc. The common English names of plants are often exceedingly numerous, and sometimes very confusing, as illustrated in the many different kinds of snake-roots; for these reasons it is best that they be supplanted, as far as admissible, by the scientific names.

(*c*) The *Latin* names of Alkaloids to terminate in *ina*, corresponding with *ine* in English, instead of *ia*; for example: Morph*ina*—Eng., Morph*ine*; Quin*ina*—Eng., Quin*ine*, instead of Morphia, Quinia, etc.

The officinal titles of the Glucosides and Neutral Principles to terminate in *inum* (English *in*), in order to avoid confusion with the alkaloids. For example: Picrotox*inum*, Santon*inum*, Eng., Picrotoxin, Santonin, etc.

(3) The adoption of *parts by weight*, and the abandonment of all measures of capacity, quantities being expressed by weight.

Since the introduction of parts by weight in the U. S. P., 1880, instead of by weight and measure, a knowledge of specific volume has become of great practical value. Through it the bulk that a preparation must attain before being finished can readily be determined beforehand after once having ascertained the specific gravity of the product.

This system, unlike those formerly in use, specifies no definite quantity, but merely the quantity by proportion of different component parts. While this proportion is expressed in decimal parts, in order to harmonize with the metric (or decimal) system of weights, it nevertheless can be applied to any other system of weights, as avoirdupois, apothecaries, troy, etc, provided that the same denomination of weight is maintained throughout any operation involving its use.

In the preparation of a tincture for example, the *strength* of the product will be the same whether 15 grams of the drug be taken for 100 grams of tincture, or 15 ounces av. to 100 ounces avoirdupois Nevertheless, since the avoirdupois system does not harmonize with a decimal system, it is more convenient to adopt metric weights, or to convert them into their equivalent in avoirdupois or troy for use. (See subject Metric Weights.)

But the decimal parts or proportions in the U. S. P. are frequently unwieldy, because the quantities to which they are adapted are at variance with the usual quantities desired by measure as quart, or pint. Thus 10 drams, 10 ounces, or 10 pounds, are quantities alike undesirable with 100 drams, 100 ounces, or 100 pounds of finished product.

The *pint* is the most convenient measure for preparing medicines; and in order that the strengths of the preparations shall be the same as though prepared "parts by weight," we ascertain the *weight of the pint;* from this the quantity of solid it contains or represents is then easily computed from the known per centage proportion. [See Specific Gravity.]

(4) In the strength of preparations, which involves a change in their doses.

This change is dependent upon the modification necessary in formulas transposed from the fractional system into one of percentage proportions. These changes, while not very great, are quite numerous, the formulas being kept as nearly the same as in the U. S. P., 1870, as is consistent with the new system of percentage relation.

(5) The introduction of several new classes of preparations, viz.:

(*a*) *Abstracts*, a class of powdered extracts intended to replace the indefinite mixtures called powdered extracts.

(*b*) *Tinctures* from fresh plants.

(*c*) *Triturations*, mixtures of powerful substances with milk sugar.

(*d*) *Petrolatum*, the new vehicle for ointments.

Metrology.—Weights and Measures.

Metrology treats of the gravitating force of a body called *weight;* its bulk or volume, called *measure*, and the relation of these to each other called *specific gravity*.

The weight of a substance is the downward pressure which the earth's attraction causes it to exert.

All bodies attract each other with a force which is directly in proportion to their mass or the quantity of matter which they contain, and inversely proportional to the squares of their distances apart. This attraction is called *gravitation*.

Since weight is due to gravity, and gravity is in proportion to the quantity of matter contained in the attracting bodies, weight, other things being equal, will vary as the quantity of matter varies, and a body with twice the quantity of matter or twice the mass of another body, will weigh twice as much. We may therefore estimate the quantity of matter a body contains by *weighing* it. In fact, for practical purposes, this is the most convenient method.

But it must be distinctly borne in mind that gravity and weight are not the same thing. Weight may vary while the mass remains unchanged. An object, for example, which at the earth's surface would weigh one pound, would, when transferred to the sun's surface, weigh about twenty-eight pounds, owing to the greater attraction by the larger planet. The weight of a substance at the sea-level is not quite identical with that of the same substance at a mountain-top, for the reason that in the latter instance, being farther from the earth's center, the attraction is less; and for the same reason it is not so great at the equator as at the poles. It must also be borne in mind that in weighing a body in the air, the air has a buoyant effect and diminishes the weight of the body in the ratio of the weight of the air which it displaces. Of two bodies, therefore, containing precisely the same quantity of matter, but the one a large body, say like a piece of cork, and the other a small one, as a piece of lead, the lead will weigh the most in the air, although a mere trifle.

In ordinary weighing, where extreme accuracy is not required, of course no corrections need be made for latitude or distance from the earth's surface, but it is not uncommonly the case, particularly in chemical research and in weighing very light bodies, that these and the buoyant effect of the atmosphere must be taken into account.

Since, also, bodies expand by heat and contract by cold, temperature must frequently be taken into account in weighing a body.

Weighing is accomplished by arbitrarily assuming a unit of weight, and then comparing the pressure of the body to be weighed, with that exerted by the unit.

The principle upon which the scale or balance is constructed is so simple and well known as to need scarcely any description. With the use of fine instruments, however, such as the prescription balance, it is well to bear in mind that they should be treated with care. The more sensitive a balance, the more delicate is the construction, especially of the knife-edges upon which the beam rests, and that of the knife-edges of the extremity of the beam from which are suspended, by means of wire, the pans.

To insure accuracy in a balance, the point upon which the beam rests must be just *above* the center of gravity of the balance; the point of suspension of the pans must be *in a line* absolutely with the fulcrum; the beam must be of sufficient strength to support the weight without bending, and the arms of the beam must be of *equal* length.

A fine balance should always be inclosed in a glass case to keep it free from dust, and more especially to protect it from the corrosive effect of acid fumes, etc., which attack the steel knife-edges, and thus impair their sensitiveness and prevent accuracy in weighing.

The *pans* of a balance should always be allowed to rest to prevent oscillating when not in use, which may be best accomplished, in the absence of a permanent fixture accompanying the balance for that purpose, by placing one pan on top of the other until wanted. Care should also be taken that corrosive articles, such as iodine, mercuric chloride (corr. sublimate), bromides and iodides of potassium, sodium, etc., when dispensed, should be weighed in glass pans, which usually accompany the balance, or in watch glasses of equal weight.

In *weighing* adhesive substances, such as extracts, etc., small pieces of white cardboard of equal weight should be used. The extract required is, by means of a spatula, placed upon one-piece, while the other serves as a counterpoise or tare upon the opposite pan. A fine balance will remain in good condition much longer when it is reserved for weighing smaller quantities only, say below one dram. It will be found very convenient to have a coarser scale on the dispensing counter for weighing quantities above one dram and for ointments, etc. A small box or vial of shot, or some similar substance, should always be near at hand, to be used in taking the tare of bottles or containers, when it is necessary to weigh fluids, or whenever a receptacle is used in weighing.

The *weights* used in weighing are usually of metal, the downward pressure of which is computed and marked according to some fixed standard.

They are commonly made of iron and brass. For delicate purposes, such as weighing with prescription and analytical balances, weights are made of aluminium wire for prescription scales and of German silver and platinum for analytical scales. These weights should be preserved in a small box or drawer, protected from dust and from the corrosive action of chemicals which would impair their accuracy. They must be kept bright and clean to be reliable, and for this reason should be handled with a pair of light forceps instead of with the fingers. Weights should be secured from reliable sources, or tested as to their accuracy.

The standard of the avoirdupois pound may be obtained (aside from the official method elsewhere described) as follows: A bar of iron, one English yard long, planed exactly one inch square, weighs about 10 pounds; one tenth of this will weigh more nearly one pound than one litre of water does one kilo [see subject Metric System].

Liquids, as a rule, are measured just as solids are weighed; nevertheless, it is frequently required that a certain liquid be weighed. While the difference between weighing and measuring some liquids is not very great, yet with others it is considerable, and, without discrimination, it may frequently produce entirely different results. [See Specific Gravity.]

Weights and Measures—(Continued).

WEIGHTS—AMERICAN AND ENGLISH.

The systems of weight in use in the United States are Avoirdupois and Apothecaries' or Troy.

Apothecaries' Weight was adopted as the official standard in all the editions of the U. S. Pharmacopœia previous to that of 1880. Although not officially sanctioned, Apothecaries weight will no doubt remain in use in the prescribing of medicines, owing to the ease with which they can be subdivided into simple fractions. One troy ounce, equal to 480 grains, is easily divided by any even number—2, 4, 8, etc. This quality is of great practical value to pharmacists and physicians. For the latter, it simplifies prescribing because of its easy division; the quantity of a remedy required for administration may be computed with the measure of the solvent very quickly in simple fractions.

The fluid measure used in pharmacy can always be reduced to drams—the equivalent of a teaspoonful. This being the measure ordinarily used in administering medicines, the quantity in a dose is readily ascertained. When, for example, one grain of morphine sulphate in one fluid ounce of water is prescribed, with directions "one teaspoonful at a dose," it is readily computed that the quantity of morphine in each dose must be one-eighth of a grain, since one fluid ounce contains eight fluid drachms or teaspoonfuls. Should eight grains of morphine sulphate in one ounce of water be prescribed with the same directions as above, the pharmacist at once computes the quantity of morphine in each dose to be one grain, and from this decides whether or not the mixture should be dispensed.

The following is a summary of Apothecaries' weight, showing the number of *grains* in each denomination:

Scruple.	Dram.	Ounce.	Pound.
20	60	480	5760

The Troy ounce, though containing the same number of grains as the Apothecaries', is divided into 20 pennyweights instead of drams and scruples.

Avoirdupois Weight is the commercial standard of the United States and Great Britain. One av. pound is equal to 7,000 grains, being 1,240 grains more than one troy pound. This difference is chiefly due to the fact that the av. pound contains 16 ounces, while the troy pound contains but 12 ounces. Why should not the difference, then, in the number of grains in the two different pounds, have the same relation as 16 to 12? If one av. pound is equal to 7,000 grains, one troy pound should equal 5,250 grains, and not 5,760 grains. Here is an unfortunate relation existing between these two kinds of weights; while the troy ounce is equal to 480 grains, one av. ounce equals only 437½ grains, which explains the difference in the number of grains to the pound.

The following table gives a summary of avoirdupois and apothecaries' weight:

480 grs.=(℥ i); then ℥ 12=5,760 grains, or 1 troy lb.
437½ " =(1 oz); then 16 oz.=7,000 " or 1 lb. av.

The number of *grains* in the various denominations are as follows:

	Dram.	Ounce.	Pound.
Avoirdupois		437½	7,000
Apothecaries' or Troy	60	480	5,760
Difference in favor of apothecaries'		42½	
Difference in favor of avoirdupois			1,240

MEASURES OF CAPACITY.

The measures of capacity in use in the United States are "Wine" and Metric measures.

The measures of bulk or volume are primarily derived from the *linear* system (measure of length) and the system of weights, in turn from that of volume.

One cubic inch of distilled water, at a temperature 62° F. weighs 252.458 grains, and 231 cubic inches is a measure equivalent to the U. S. gallon.

The *Gallon* is divided into eight pints; one *pint* into 16 fluid ounces; one *fluid ounce* into 8 fluid drams, and 1 fluid *dram* into 60 *minims*.

The measure of volume may therefore always be compared with the weight of water (at 62° F.), the standard for comparison, thus:

1 cubic inch=252.458; 252.458×231=58,318 grs.=1 gall.
58,318÷8=7,290 grs.=1 Pint.
7,290÷16 = 455.6 grs.=1 Fluid Ounce.
455.6÷480= .949 grs.=1 Minim.

These are the exact weights of the respective measures at the mean temperature, but the comparison is frequently made at a lower temperature. Water reaches its maximum density at 4° C., when one pint weighs 7,302 grains, and this is the standard adopted by many foreign works. In these lectures the round number, 7,300 grains, equivalent to one pint, has been adopted as sufficiently accurate in comparing weight with volume.

Measure, in pharmacy, is a term usually applied to a certain standard for estimating the dimensions of liquids, or the capacity of vessels used as containers. When of the larger dimensions, measures are made of copper or tinned iron. Preferably the latter, because it is not so easily dented as copper.

In the dispensing of medicines, graduated glass measures are used; they should always be tested with measures of known accuracy, or by weighing their capacity of pure water, which should be a certain weight, if the measure be correct. [For testing any measures of capacity, refer to standard for weights.]

A *drop* is not a minim, and the measurement of liquids by drops does not give uniform and accurate results. The size of drops varies greatly with different liquids; also with the same liquids, according to the conditions governing the process of dropping. Among these conditions are, chiefly:

(1) The quantity of the liquid contained in the vessel.
(2) The size and shape of the lip of the vessel.
(3) The rapidity of the dropping.
(4) The temperature of the liquid.

The size of a drop cannot be estimated by the specific gravity of the liquid, since some substances of great density (*e. g.*, chloroform) yield smaller drops (300 to 1 dram) than those obtained from liquids comparatively light, as for instance, ether.

The size of drops of different liquids, estimated by the number to one fluid drachm, may be generalized as follows:

	Drops in one fluid dram.
Watery solutions, including dilute acids	50 to 60
Alcohol and strongly alcoholic liquids, spirits and tinctures	120 to 140
Alcohol dilut., including tinctures from the same	100 to 120
Ether and ethereal prep., including spirit ether. nit.; sp. ether. comp	120 to 150
Oils, ethereal	90 to 110
Oils, fixed; glycerin	65 to 80
Chloroform	200 to 300

The Metric System.

The Metric System of weights and measures was originally introduced in France, at the close of the eighteenth century; hence it is frequently termed the French system. Although universally applied in scientific work, and the only legally recognized standard in most European countries, Great Britain notably excepted, it has, even in these countries, far from displaced the old weights and measures, pound and pint, in use in all civilized countries with certain modifications.

There is no doubt that, for scientific work, where precise calculations are required, the metric system is far superior, both in results and facility of application, to the older forms, either avoirdupois or troy. In such work, however, as does not require exceedingly great scientific accuracy, and where the results are considered from a commercial standpoint, many objections to its use arise, which cannot easily be met until such time as the general demand for its application is complied with by all classes of trade, and by the public at large.

The first step to bring this system prominently before the pharmaceutical profession was taken when, by a close vote, the committee on revision of the U. S. P., 1880, was directed to construct that work in conformity with the metric system by adopting *decimal parts by weight* throughout, with the exception of a single class of preparations.

In view of the prospective use of the metric system in medicine, it is necessary that pharmacists familiarize themselves with it, at least sufficiently to be able to convert its different quantities into troy weights or grains, and fluid measure of ounces, drams, etc. This conversion is not necessary for the purpose of substituting troy weights or U. S. measures for those of the metric system when these latter are directed, but to enable the pharmacist to estimate approximately the bulk or volume of mixtures, etc., in order to choose containers of the proper size, and to facilitate dispensing in various other ways, as well as computing the *price* of the finished preparation. The quantity of active remedies should also be known in *grains*, that the dispensing of overdoses may be avoided.

The *Metric System* is based upon the *meter*, which is the standard *unit* of linear measurement, being the ten-millionth part of one-fourth of the circumference of the earth (the quadrant).

One *meter* is equal to 39.37+ inches.

The standard *unit* of *fluid measure* (termed the Liter) is the cube of one-tenth of the meter, or cubic decimeter, and one thousandth part of it, or the cube of one-hundredth of the meter is *one cubic centimeter* and weighs 1 Gram, if distilled water.

The *unit* of *weight* is the weight of one cubic centimeter of water at its maximum density, termed *gramme* or *Gram*, equivalent to 15.432 grains.

The unit *Gram* (written with a period immediately following, thus, 1.) is divided or multiplied to express smaller or larger quantities respectively, by simply moving the decimal point to the *left* or to the *right*.

To designate the quantities thus obtained, *Latin* prefixes are used to describe those less than one Gram, and *Greek* those larger than one Gram, as shown in the following:

		Grains.
1.	=1 Gram, (abbrev. Gm.)	=15.432
.1	=1 decigram, (" dcg., or dg.)	= 1 543
.01	=1 centigram, (" cntg., or cg.)	= 0.154
.001	=1 milligram, (" mg.)	= 0.015

		Grains.
1.	=1 Gram, (abbrev. Gm.)	= 15.432
10.	=1 Dekagram, (" Dg.)	= 154.32
100.	=1 Hectogram, (" Hg., or Hecto.)	= 1543.2
1000.	=1 Kilogram, (" Kg., or Kilo.)	=15432.
		=2 lbs. 3 oz. av. 120 grains.
10000.	=1 Myriagram, (" Mg.)	=154320. grains.
		=22 lbs. av. 320 grains.

TABLE OF METRIC WEIGHTS.

1 milligram	=0.001 gram.						
10 milligrams	=	1 centigram	=0.01 gram.				
100 "	=	10 centigrams	=	1 decigram	=0.1 gram.		
1000 "	=	100 "	=	10 decigrams	=	1 Gram.	
10 grams	=	1 Dekagram.					
100 "	=	10 Dekagrams	=	1 Hectogram.			
1000 "	=	100 "	=	10 Hectograms	=	1 Kilogram.	

Various methods have been proposed for adapting the metric weights to our troy weights used in prescription writing without entailing calculations in fractions. The method of taking 32 grams as equivalent to one troy ounce, and 30 C. c., or fluid grams, as equal to one fluid ounce, seems to be the least objectionable. These equivalents are shown in the following:

32 Gm. =1 oz.; 32÷8=4. Gm. =1 dram.
30 C. c. =1 fl. oz.; 30÷8=3.75 C. c. =1 fl. dram.

The exact metric equivalent of 1 grain is obtained by dividing the unit by the gram equivalent in grains, thus: 1.÷15.432=0.0648 gram.

The metric equivalents of all the other denominations may be obtained by multiplying the grain equivalent by the number of grains in one dram; the number of drams in a troy ounce, etc. The following exact gram equivalents are thus obtained:

1 grain.	1 dram.	1 ounce av.	1 ounce troy.	1 lb. troy.	1 lb. av.
0.0648	3.888	28.349	31.103	373.250	453.592

To convert avoirdupois or troy into metric weights, the equivalent of the gram in grains—15.432—should be remembered, as it serves the purpose of a basis for obtaining the equivalent of all the higher denominations.

It will be observed that this number is composed of the first five numerals in reversed order, except the figure 1. In round numbers the gram is said to equal 15 grains, the fraction being dropped, which, multiplied by 4, gives 4 grams, equal to 60 grains or 1 dram; and these multiplied by 8—the number of drams in one ounce—give 32 grams, equal to one troy ounce.

To convert metric weights into avoirdupois or troy, the easiest plan is to multiply the quantity in grams by 15 securing the weight in grains. This is then readily brought back to the larger denominations by dividing it with the number of grains to the dram, ounce or pound. For example;

1452.5 (grams)×15=21,787.5 grains.
21,787.5÷7000=3 lbs. av., 1 oz. av., 350 grains.

With a small number, as, for example, 24 grams, this calculation may readily be made mentally by adding one-half of the number to the original and then taking it tenfold, thus; 24 grams:

24+12=36×10=360 grains.

[For further comparison of the different systems of weights, refer to Oldberg's "Weights, Measures and Specific Gravity" See also Table of Equivalents in the U. S. P.]

Specific Gravity.

It is well known that some liquids are lighter than water, *i. e.*, ether, alcohol, etc.; others again are heavier, *i. e.*, glycerin, sulphuric acid, etc. The weight of a certain measure of any of these liquids divided by the weight of the same measure of distilled water is termed the specific gravity of that liquid.

Thus, if a bottle hold exactly 1,000 grains of water, but of alcohol only 820 grains, the weight of the latter is as 820 is to 1,000. Water being the standard for comparison, it is stated to be 1., and if the weight of the liquid is lighter than water, as in the above instance, it becomes a decimal of 1., or, in this example, 0.820. If the bottle is filled with a liquid heavier than water, as, for example, glycerin, of which it would hold 1,250 grains, the weight is compared similarly, viz, 1,000 is to 1,250 as 1. is to 1.25, the specific gravity of glycerin.

The specific gravity (or specific weight) of a substance is its *weight* in comparison with *weights* of similar *bulks* or volumes of other substances, or the relative weights of *equal* bulks of *different* bodies, compared with some definite standard at the same temperature.

The standard for comparing this difference of liquids and solids (not gases) is distilled water at a certain temperature, viz., 59° F., U. S. P.

Example.—A certain quantity of glycerin equal in volume to 100 grains of water weighs 125 grains; if we divide the weight of the glycerin by the weight of the water, the quotient will be the specific gravity of the glycerin. Thus: 125 divided by 100=1.25 specific gravity.

Since all bodies expand or contract with changes of temperature, it is essential in comparing this difference in weight that the temperature of the substance be the same as that of the standard for comparison, water, viz., 60° F.

The mean temperature 15° C. is employed in the U. S. and other Pharmacopœias as the standard. Its exact equivalent is 59° F., but it is frequently taken in round numbers as 60° F.

Constancy in temperature is especially to be observed in taking the specific gravity of liquids, since, with the exception of the metals, they are much better conductors of heat than solids, and more readily expand and contract. Alcohol, ether and benzin, for example, increase in bulk in proportion to the height of the temperature to which they are exposed, while they decrease in proportion to the degree of cold they are subjected to.

As a rule, the lighter the liquid compared with water, the more its bulk is changed by the temperature, *e. g.*, alcohol, ether, benzin. Conversely, the heavier the liquid as compared with water, when not below the freezing point, the less its bulk is changed by the temperature, *e. g.*, acids, glycerin, syrups.

With solids these rules are reversed. *Heavy* substances, such as metals, contract and expand, as illustrated in iron rails. *Light* solids are scarcely affected at all, such as glass, wood, coke, etc.

The determination of the specific gravity of liquids, although an operation which should be practiced daily in the pharmacy, is nevertheless a process seldom attempted, and even the subject is one which is rarely understood thoroughly, even by those regarded as otherwise well qualified. This is chiefly owing to the fact that no practical demonstration is made at the time the subject is treated.

There exists in the mind of the beginner an exaggerated idea as to the implements or apparatus required for its performance, and as these usually are not at hand, he is disposed to content himself with learning the rules from the books, and, as a consequence, soon forgets the principles involved.

This is entirely wrong. Practical demonstration at the time is the only means by which the principle can be thoroughly understood. While it is true that for great scientific accuracy delicately constructed instruments are required, sufficiently accurate results for all practical purposes may be obtained from the use of the ordinary apparatus in every pharmacy.

The necessary apparatus for taking the specific gravity of substances is primarily a good balance, sensitive to at least 1 grain, and accurate weights; also a specific gravity bottle of known capacity by weight of water, the most convenient quantity being 1,000 grains. Such bottles are in the market, provided with a glass stopper, and accurately adjusted to hold, when completely filled, exactly 1,000 grains distilled water at 60° F. An opening barely sufficient to admit a small needle permits the escape of air, which may have entered the bottle while being filled, as well as any superfluous liquid.

In the absence of a counterpoise, which usually accompanies the bottle, one is easily made from a piece of lead or other metal; or the tare of the bottle may be taken with ordinary weights. When first procured, the bottle should be invariably tested as to its accuracy, by filling it with distilled water at 60° F., then wiping it dry, and weighing, when it should indicate 1,000 grains.

Glass-stoppered one-ounce iodine vials may sometimes be found which hold a convenient volume of water, and by making the incision lengthwise upon the stopper with a three-cornered file, an opening is produced, which answers the same purpose as the orifice in the more expensive vials above described.

Bottles may also be selected from the ordinary prescription vials; for example, a one-ounce vial is filled with distilled water at 60° F., and marked, with a file, on the neck at such point as may indicate a convenient even number of grains of water. Such vial is not as accurate, however, as the glass stoppered bottles, nor as convenient, since it involves more calculation.

Furnished with any of these objects, the veriest beginner in pharmacy can take the specific gravity of any liquid, the simplest knowledge of arithmetic being all that is required. It should be remembered that the thing sought is the weight of a quantity equal in bulk to a certain volume of water of known weight, or, as above expressed, the *relative* weights of *equal* volumes, or bulks of *different* liquids at the *same* temperature. A certain volume being decided upon as a standard for comparison, we express that by weight of water, and the weight of an equal bulk of any liquid is divided by this weight. When this standard for comparison can easily be converted into a multiple of ten, the division is effected by simply moving the decimal point to the left or right, as for example:

Glycerin.	Water.		Alcohol.	Water.	
1,250	÷ 1,000	= 1.250 sp. gr.	820	÷ 1,000	= 0.820 sp. gr.

Specific Gravity—(Continued).

In proceeding to ascertain the specific gravity of a liquid, the bottle should first be rinsed with a little alcohol, which volatilizes more quickly than water, and leaves the bottle perfectly empty. After having ascertained the temperature of the liquid, which, as stated, should be 60° F., the bottle is filled nearly to the top of the neck, the stopper is inserted and the superfluous liquid displaced by it completely removed from the bottle, which is then wiped perfectly clean and dry. The filled bottle is then weighed, after being balanced with the counterpoise. If the weight of the liquid is 1,250 grains, the specific weight is 1.25 (1,250 ÷ 1,000). The weight of the water, whatever the quantity, is always taken at 1. and the weight of the water is always in proportion to this unit.

Bottles for ascertaining the specific gravity are also made holding 500 grains of water. The operation is the same with these as that employed for the 1,000 grain bottle, except that the weight of the liquid is multiplied by 2 and divided by 1,000.

The specific gravity or density of liquids is also frequently designated by the number of degrees indicated by the hydrometer—*e. g.*, B. 18°.

Hydrometers are instruments made of glass, consisting of a bulb filled with some heavy substance, such as shot or mercury (which maintains the instrument when immersed in the liquid in an upright position), and a graduated stem. These instruments are used only for commercial purposes, since they are not sufficiently accurate for scientific work, nor is their use recognized in the U. S. P. They are designed for special classes of liquids, and named accordingly, alcoholometers, acidometers, saccharometers, urinometers, etc.

Baume's hydrometer is of two kinds: (1) for liquids *heavier* than water; and (2) for liquids *lighter* than water. Although they were the first to become extensively employed, their use is being rapidly superseded by hydrometers whose scales also give the actual specific gravities, thereby rendering conversion unnecessary.

As these standards are still in use in the arts, the following rules for converting them into sp. gravity are convenient:

For liquids *heavier* than water: subtract the degree of Baume from 145, and divide 145 by the remainder thus obtained. The quotient is the specific gravity.

For converting the specific gravity into Baume, reverse the process.

For liquids *lighter* than water: add the number of degrees to 130, and divide 140 by the sum thus obtained; the quotient is the specific gravity. To reduce s. g. to B. divide 140 by the s. g. and subtract 130 from the quotient; the remainder will be the degree Baume.

Specific Gravity of Solids.

The specific gravity of solids is determined by *dividing the weight* of the *substance* by its *loss* of weight in *water*.

This loss represents the weight of an equal bulk of water and depends upon the law of Archimedes, viz.: that bodies immersed in a liquid are buoyed up with a force *equal* to the weight of the liquid displaced.

It should be borne in mind that in all calculations to find the specific gravity of solids, whether in mass or powder, heavier or lighter than water, soluble or insoluble in this liquid, the main object sought is the *weight of a quantity of water equal in bulk to the substance*, the specific gravity of which is to be found.

In *determining* the weight of an equal bulk of water, the methods employed must necessarily vary with the difference in the physical properties of the substances. All solids come under one of the following divisions:

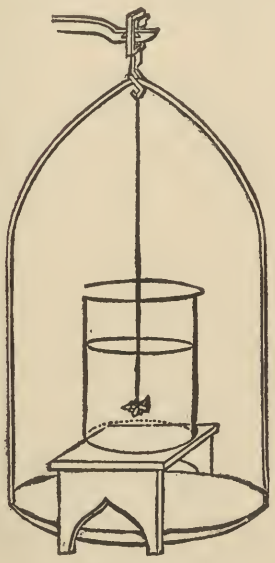
(1) A mass heavier than water:—Divide the weight in air by the loss of weight in water.

Example:—A substance weighed in the air, weighs 500 grains; its weight in distilled water, when completely submerged, is 400, loss 100 grains; hence the s. g. of the substance is 5. (500÷100=5).

(2) Mass lighter than water:—Divide the weight in air by the weight required to restore the equilibrium, when weighed in water.

The substance is weighed with a body attached to it of sufficient weight to keep it immersed in the water; the heavy body having first been *counter-poised* under water, in order that the conditions shall be equal.

Example:—A piece of iron, suspended by means of a silk thread or horsehair, attached to the end of the beam of a scale, is weighed in water contained in a beaker placed so as not to interfere with the full movement of the balance. It is *counter-poised* by the necessary weight placed upon the opposite pan. A piece of wood weighing 12 grains is attached near the iron, both being immersed in the water, but the wood being lighter, is buoyed up with a force equal to the liquid it displaces, and carries the iron upward to the surface of the liquid. To restore the equilibrium of the balance it requires an additional weight of 23 grains, which represents the weight of a bulk of water equal to the bulk displaced by the wood. Then 12 divided by 23=.5217 sp. gr. of wood.



(3) Mass soluble in water.—Divide the weight in air by the loss of weight in some liquid in which it is not soluble, and multiply by the specific gravity of the liquid.

Example:—A piece of sulphate of copper weighs 300 grains in the air; in oil of turpentine it weighs 186 grains, loss 114 grains; the original weight (300) divided by 114, gives 2.63, which multiplied by .88 (the sp. gr. of the oil of turpentine previously ascertained), is 2.3144, the sp. gr. of the sulphate of copper.

The Specific Gravity of Powders, as in the manipulations of the specific gravity of solids in mass, is found by ascertaining the amount of liquid the powder displaces when weighed in a specific gravity bottle.

The same principles govern and the same rules should be applied as with masses, according as the powders differ in physical properties.

Parts by Weight.

The introduction of parts by weight in the Pharmacopœia was, to the great majority of druggists throughout the country, a novelty. It was construed, and is by many still believed, to have been an attempt to direct the employment of the weights of the metric system. While this, of course, was the ultimate intention of the Committee on Revision, the parts by weight system was simply introduced, leaving the choice of weight open to the dispenser, but it would have been far better if a percentage system were a necessity, to adopt *both* the measures and weights of the metric system.

By expressing quantities of solids in grams, and liquids in its nearly corresponding equivalent, *cubic centimeters*, the principal objection to the present system would have been removed. All difficulty in computing the exact strength of liquid preparations would be avoided, since the variation in specific gravity, which largely influences their strength, would not then need be considered.

Parts by weight is a percentage system capable of being applied alike to any kind of weight. Thus, a formula reading: Of the drug 10 parts, alcohol sufficient to make 100 parts, may be applied to grains, drams, ounces or pounds, just as well as to grams or kilos. Here is where the impracticability of this system is chiefly apparent; if a tincture is to be prepared, 100 grains is too small a quantity; of 100 grams the same may be said; besides, the metric weights are seldom found in drug stores in such large denomination, and conversion into avoirdupois is too laborious or liable to cause error. If 100 drams be taken, the quantity of finished tincture is nearly the quantity often required, viz., one pint; obtained thus: $60 \times 100 = 6{,}000$ grains. But, since one pint of water weighs 7,300 grains (approx.), there must be a difference of 1,300 grains, or nearly three ounces, apparently, and, according as the finished preparation be specifically lighter or heavier than water, will its measure be nearer or further removed from that much to be desired quantity, *i. e.*, a pint. Hence the necessity of knowing the specific gravity of liquids in their preparation, tinctures especially, to determine their measure, in order to avoid the inconvenience of weighing from time to time to determine the completion of the process, if for no other reasons. The weight of the tincture as compared with its measure, specific gravity, accounts for the difference.

If the same principle had obtained with all liquid Galenical preparations as in the fluid extracts, namely, giving the equivalent in the metric measure, the *measure* of all preparations being fixed in formulas, their strengths could be computed by simply reducing the metric terms in their respective equivalents of U. S. weights and measures. For example:

One gram tolu = 15 grains tolu
in in
10 C. c. tincture = 150 minims tincture (approx.)

The ease with which this system—weight for volume—can be applied, compared with that of parts by weight, is strikingly shown in the following: Taking the same example, Tincture of Tolu, as an illustration, it is desired to find its strength—that is, the amount of tolu in a certain bulk expressed in grains and fluid measure·

500 grams of the tincture, prepared according to the U. S. P., is found to measure 19¼ fluid ounces. The 50 grams of tolu is equivalent to 771.6 grains, which, divided by the number of fluid ounces, gives the amount of tolu contained in 1 fl. ounce thus:

$771.6 \div 19.25 = 40$ grains, tolu.

This amount (40 grains) multiplied by the number of fluid ounces in one pint, gives the quantity of tolu (in grains) represented in one pint of tincture of tolu, prepared parts by weight.

$40 \times 16 = 640$ grains, tolu.

This calculation, as in all examples of converting parts by weight into grain weights and fluid measures, is only approximately correct—a disadvantage which prevents the general application of the system.

Specific Volume.

The specific volume of liquids is the *opposite of specific gravity*, and is expressed in *inverse* ratio to specific gravity.

As the specific gravity of a liquid is the weight of a certain volume of that liquid *divided* by an equal volume of water, so the specific volume of a liquid is the *quotient* obtained by dividing the volume of a given quantity by weight of that liquid, by the volume of an equal weight of water, thus:

Glycerin. Water. Specific volume.
1.00 divided by 1.25 = .80

Distilled water at 60° F. is the unit or standard taken *by weight* when compared with the U. S. fluid measures, for the reason that no corresponding relation exists between U. S. fluid measure and avoirdupois weight. One hundred ounces av. of water measure 96 fluid ounces; hence the volume of 100 ounces av. of any other liquid may be obtained, expressed in fluid ounces, by multiplying its specific volume by 96. For example:

Glycerin. Water.
1.00 ÷ 1.25 = .80 specific vol.; .80 × 96 = 76.8, number of fluid ounces in 100 av. ounces.

In making syrup, for example, 65 parts (6½ pounds) of sugar are to be dissolved in sufficient water to make 100 parts (10 pounds). What should be the bulk of the product?

The specific gravity of syrup is 1.310; divide 1. by 1.310 = .76335 specific vol.; .76335 × 96 = 73.28, number fluid ounces in 100 av. ounces; 73.28 ÷ 100 × 160 = or 117.25 fl. ounces in 10 pounds of the syrup.

In the same way it will be found of great advantage in making tinctures by percolation, to ascertain the volume the finished preparation shall attain, and mark the quantity on the receiving bottle; when the volume is reached, the product, if otherwise correctly prepared, should also have the weight required by the U. S. P. The specific gravity of the preparation must be obtained from a specimen of the same preparation accurately compounded. In the absence of a sp. gr. bottle, the sp. gr may be obtained by dividing the weight of one *pint* of the preparation by the weight of one pint of water (7,300 grs.), thus:

Example.—One pint tincture = 14 av. ounces (6,125 grs.); 6,125 ÷ 7,300 = .839 sp. gr.

Take, for example, a tincture prepared with alcohol (sp. gr. 0.820) from 15 parts of the drug in 100 parts of tincture by weight. The sp. gr., if not otherwise obtainable, may be taken to be the same as that of the menstruum employed, viz., 0.820; this number, multiplied by the weight of one pint of water, the standard for comparison, gives the weight of one pint of the tincture, thus:

$0.820 \times 7{,}300 = 5{,}986$.

This is not absolutely correct, as the density of the tincture is somehow greater than that of the menstruum employed, owing to the extractive matter of the drug in the tincture; but, by taking the above 5,986 in round numbers, 6,000 grains, we obtain the weight of one pint sufficiently correct for all practical purposes. The strength of the tincture is then obtained by simply multiplying the percentage strength by the weight of one pint of the tincture, thus·

6,000 × .15 = 900 grains of drug to one pint tincture.

Nearly all tinctures directed to be prepared "parts by weight" may be calculated in the above manner; for syrups and preparations involving greater change in density between the solvent and the finished preparation, it is necessary first to obtain the specific gravity.

Specific Gravity Table.—Thermometers.

The application of specific gravity in pharmacy is as indispensable as a thorough knowledge of the subject is necessary. It is the simplest method of estimating the strength of most chemicals in liquid form, and of comparing them with the standards adopted in the U. S. P. While such estimation does not exclude a possibility of adulteration, and perhaps of deficiency in strength, it may be regarded as a criterion of strength, and frequently, also, of purity, when applied to substances so largely used as alcohol, glycerin, ether and the acids, *e. g.*, hydrochloric, nitric, sulphuric, etc.

Table of Specific Gravity and Volume of Officinal Liquids.

The specific gravity of the various liquids in this table should be memorized. With a knowledge of the specific gravity of any liquid, it becomes an easy matter to calculate the *volume* of any quantity *by weight*, and vice versa. The weight in av. of 100 and of 16 fluid ounces (the latter calculated upon a basis of 7,300 grs. as the weight of one pint of water), is shown in the following table :

Liquid Temp., 15° C. (59° F.)	Specific Gravity.	Weight of 100 Fl. Oz. in Av. Oz.	Weight of One Pint. in Av.	
			Oz.	Grains.
Benzinum	.670	69.8	11	78.5
Æther Fortior	.725	75.5	12	42.5
Æther	.750	78.1	12	217.
Alcohol at 15° C	.820	85.4	13	298.5
Spir. Ætheris Nitrosi	.824	85.8	13	327.7
Oleum Terebinthinæ	.862	89.8	14	167.6
Oleum Adipis*.	.900	93.75	15	7.5
Aqua Ammoniæ Fortior	.900	93.75	15	7.5
Acid. Oleicum	.900	93.75	15	7.5
Spir. Furmenti	.920	95.8	15	153.5
Alcohol Dilutum	.928	96.7	15	211.9
Spir. Vini Gallici	.930	96.9	15	226.5
Aqua Ammoniæ	.959	99.9	16	7.0
Aqua Distillata	1.000	104.17	16	300.
Vinum Album	1.000	104.17	16	300.
Vinum Rubrum	1.000	104.17	16	300.
Acid. Aceticum Dil	1.008	105.0	16	358.4
Liquor Potassæ	1.036	107.9	17	125.3
Acid. Aceticum	1.048	109.1	17	212.9
Acid. Hydrochlor. Dil	1.049	109.3	17	220.2
Oleum Caryophylli	1.050	109.4	17	227.5
Acid. Phosphoricum Dil	1.057	110.1	17	278.6
Liquor Sodæ	1.059	110.3	17	293.2
Acid. Nitricum Dil	1.059	110.3	17	293.2
Acid. Sulphuricum Dil	1.067	111.0	17	351.
Acid. Hydrobrom Dil	1.077	112.2	17	424.6
Oleum Sassafras	1.091	113.6	18	89.3
Acid. Hydrochloricum	1.160	120.8	19	155.5
Liquor Ferri Acet	1.160	120.8	19	155.5
Oleum Gaultheriæ	1.173	122.2	19	250.5
Acid. Lacticum	1.212	126.2	20	97.6
Glycerinum	1.250	130.1	20	375.
Carbonei Bisulphidum	1.272	132.5	21	98.1
Acid. Hydrobrom., 34%	1.303	135.7	21	324.4
Syrupus (Simplex)	1.310	136.4	21	375.5
Liquor Ferri Tersulph	1.320	137.5	22	11.
Mel	1.333	138.8	22	105.9
Acid. Phosphoricum	1.347	140.3	22	208.1
Liquor Ferri Chloridi	1.405	146.4	23	194.
Acid. Nitricum	1.420	148.0	23	303.5
Chloroformum venale	1.470	153.1	24	231.
Chloroformum purific.	1.488	155.0	24	362.4
Acid. Sulphuricum	1.840	191.7	30	307.

*The equivalents of oils approximate these numbers, their specific gravity being nearly .900. Fixed oils are generally somewhat higher (ol. olive .916), while ethereal oils are lower (ol. lavandula .890), except those given in this table.

Thermometers.

The extent of the expansion or contraction of a given substance by the addition or subtraction of heat, expressed in parts or degrees, constitutes the usual method for estimating the degree of sensible heat imparted by a body—in other words, the degree of its temperature.

Since the expansion and contraction in volume are constant with the changes in temperature, the extent of variation may be best determined by the fluids usually employed — mercury, because of its regular expansion, and because it boils only at a very high temperature ; and alcohol, because it does not solidify at the greatest known cold.

Thermometers are instruments made of a glass tube, with a bulb at one end filled with mercury or alcohol, the tube being attached to a graduated scale ; the mercury rises and falls in the tube as its volume is increased by heat or decreased by cold.

Unfortunately, no less than three standards have been adopted for thermometers, termed respectively : Reaumur, Celsi, and Fahrenheit.

In Reaumur's scale, zero is at the freezing point of water, and 80° the point at which water boils.

In the Celsi or Centigrade (from Celsius, its discoverer), the zero point is also that of freezing water, but the boiling point is fixed at 100°.

In Fahrenheit's, the freezing point of water is at 32°, and that of boiling water is at 212° ; hence the number of degrees between these two standard points in this thermometric scale is 180, instead of 80° and 100° in Reaumur and Celsi respectively. The point 32°, taken for the freezing point of water in Fahrenheit, instead of 0 as in the other scales, is explained by the fact that it was the lowest degree of cold known up to the time of the construction of the Fahrenheit scale.

The Fahrenheit thermometer is almost exclusively used in the United States, except for scientific use. The Celsi is becoming the standard authority in scientific work, owing to its centesimal scale being in harmony with the metric system of weights and measures.

In converting the degrees of one scale into either of the others, we must find a number which is divisible into the three respective numbers : 80, 100, and 180, without any fraction. Such a number is 20, and the quotients obtained, viz.: 4, 5, and 9, express the number of degrees in each scale equivalent to the same degree of temperature. In Fahrenheit, the 32 degrees between freezing-point and zero must invariably be added when the degrees of other scales are converted into it, after the degrees have been made equivalent to the proportion just named.

In reducing Fahrenheit to Celsi and Reaumur, the 32 degrees are first subtracted, and then the remaining degrees are reduced to the equivalent proportions.

Examples.—To convert 10 Celsi degrees to those of Fahrenheit, multiply by 9, divide by 5, and add 32 ; equal to 50 deg. F. To reduce 40 Fahrenheit degrees to those of Celsi, subtract 32, multiply by 5, and divide by 9 ; equal to 4.44 deg. C. To reduce F. to R., subtract $32 \times 4 \div 9$. [For table of Thermometric Equivalents, see U. S. Pharmacopœia.]

Important Notice.

1. The Lectures are mailed to the Student *invariably* upon the first and fifteenth of each month. From this there is absolutely no deviation, except when the class is notified to the contrary, or when these dates fall on Sunday, or holidays, when the Lectures are sent the day following.

2. Every precaution against any omission is taken, each Lecture as addressed to the student being checked by the Director in the Class Book.

3. Students not well known to the Postmaster in their locality are advised to suggest to him the importance of prompt and careful delivery of their mail. It is best to take all possible precaution against non-delivery or irregularity, in order that the Student will lose no time or fall behind in the Class.

4. If the Lecture is not received within the usual time, notify the local post-office, and, if not then obtained, advise the Director *at once*, by postal card.

5. Request for *change* in address must be received 5 days *in advance* of the "mailing days," in order to be acted upon then, and must give *former* address and class page.

IN ANSWERING THE QUESTIONS.

In order to facilitate the examination of replies to questions by the Director, Students are requested carefully to observe the following rules. A *deduction of 10 per cent. from the average* will be made for failure to comply with these instructions :

6. Write on *one side* of the paper only, and in *ink*, on LETTER size only, and not on cap or note paper.

8. Write the number of the Lecture (in Roman), *Name* and *full address*, your *class page*, and also the date of answering, at the *top* of the first page of your answers, thus :

Lecture....., Term I. Date.....

Joseph L. Weil,

Class page..... 521 Penn St., Reading, Pa.

9. Write the *number* of the Question in the margin and in Arabic (19), not *Roman* (XIX) numerals.

10. Make a *separate* Paragragh of each Answer, and allow one line *blank* between each.

11. Write upon the *first* and *third* pages of each four-page sheet only.

IN ANSWERING THE QUESTIONS.

12. Upon receipt of a Lecture, the accompanying Questions should be answered before that Lecture is studied and as promptly as possible.

13. This should be done without reference to the Lecture to which they apply, and whenever possible at one "sitting." In the evening, after closing, when not interrupted, one hour's time will usually be sufficient.

14. In order to derive the greatest benefit, the Student should refer to the Lectures and to Text Books only *before* or *after* answering the Questions. The Questions should be answered in the Student's own way, in his own language. Only in this way will the most benefit be derived from study.

15. After having copied and mailed the Answers, the study of the Lecture should be commenced, and may be finished by the time the Observations on the Answers to the previous Lecture arrive.

16. The subjects in the previous Lecture are then reviewed, doubtful points being cleared up by aid of the Observations and reference to further Text Books, when necessary. The interval to receipt of the next Lecture may thus be improved with the greatest possible advantage.

17. Upon receipt of the next Lecture, the same system is observed, and so continued until, almost before the Student is aware of it, the Term is finished.

IN TRANSMITTING.

18. Send sheets *whole*. When more than one, do not pin or paste them ; simply fold them together.

19. Enclose the paper in a *large* envelope, so as to avoid too many creases.

20. Address the envelope distinctly to "*Director National Institute of Pharmacy, 69 Dearborn St., Chicago.*

21. In mailing, remember that letter postage is *two cents per ounce* or any fraction of an ounce.

REMARKS.

22. All inquiries regarding the subjects in the Lectures must be written upon letter paper, following the replies to the printed questions.

23. Inquiries or other communications not directly related to the Lectures, such as ordering Text Books, etc., must be written upon a *separate sheet of paper*, though they may be enclosed with the replies.

24. Missing sheets of the Lectures will be supplied upon application, but only upon *receipt of postage.*

25. By adhering to the above rules the replies will be very uniformly received and promptly examined. It is rarely the case that letters go astray when properly mailed.

26. Observations on, or corrections of, replies, except of subscribers in the Territories and Coast, may be expected in about a week after they have been received. As a rule, those most promptly received are first examined, and observations consequently transmitted most quickly. As it is desirable that all observations should reach the Students before the next Lecture is sent, it is especially requested that answers be sent in as soon as possible.

27. Complaints have sometimes been made that no acknowledgment of answers has been received by the Student. In such cases the fact is that the *signing* of the paper is neglected, when no means are at hand to identify its authorship. The post-mark sometimes avails, but frequently it is obliterated, and then there is no recourse but consign the paper to the waste-basket, much as it is to be regretted.

28. A very excellent plan is to affix the name and address with a rubber hand-stamp (upon both sheets, if more than one) ; these are to be procured for a trifle, and may also be used for the envelope.

29. The number of your "class page" will be forwarded with our corrections on your answers to Lecture I, after which state your "class page" on *every* communication.

Very truly, THE DIRECTOR.

National Institute of Pharmacy.

LECTURES, SEMI-MONTHLY, BY MAIL.
C. S. HALLBERG, Ph. G., *Director.*

DEPARTMENT OF EXAMINATIONS.

CHICAGO, June, 1891.

C. F. Carpenter, East Hampton Conn.,

Upon Questions on Lecture I., Series S, we transmit the following printed answers for further comparison and study:

1. A Pharmacopœia is a standard adopted by representative pharmaceutical and medical authorities for the identification, preparation, purity and strength of officinal substances.

A Dispensatory is a commentary or elaboration of a pharmacopœia, compiled and arranged by private persons.

2. ——

X 3. It is not a science but more properly an art requiring a knowledge of several sciences; in other words a scientific art.

4. Once in ten years, to periodically reconstruct it in accordance with the advancement and requirements of pharmaceutical practice.

5. (a) The department of Physics treating of weight and measure and their relations.

X —(b) By weight and measure.

6. The balance should oscillate easily and regularly, and be sensitive to a certain required weight; the beam should remain inflexible under the greatest load the balance is designed to bear; equal loads upon the pans should balance when the pans are transposed; unloaded pans should also balance when exchanged, etc.

7. It varies with the liquid, its temperature, rapidity of dropping, quantity of liquid in vessel, etc.

8. ——

9. 7000÷480=14.58+Troy ounces.

10. ——

11. ——

12. (a) 455.7 grains (weight of 1 fluid ounce water)÷480 (minims in 1 fluid ounce water)=0.949+grain.

(b) 480 minims÷455.7=1.05+minims.

13. (a) 455.7 grains (weight of fluid ounce of water)×1.84 (specific gravity of Sulphuric Acid)=838.5 grains.

(b) 480÷838.5=.572+fluid ounce or 4.576 fluid drachms.

14. 15°C. or 59°F.

15. (a) 7300×0.820=5986 grains Alcohol.

(b) 7300×1.42=10366 grains Nitric Acid.

(c) 7300×1.48=10804 grains Chloroform.

(a2) 5760 grains÷0.820÷455.7=15 fl. ozs., 3 fl.drs.

(b2) 5760 grains÷1.42÷455.7=8 fl. ozs., 4 fl. drs.

(c2) 5760 grains÷1.48÷455.7=8 fl. ozs., 4 fl. drs.

16. ——

17. Multiply the weight of an equal measure of Distilled Water by the specific gravity of the liquid.

18. 7300 grains×0.90 (sp. gr.)=6570 grains=weight of a pint of finished tincture; 20 per cent. of which is 1314 grains =weight of drug in a pint of Tincture.

19. Divide the measure of an equal weight of Water by the specific gravity of the liquid, or multiply it by the specific volume.

20. 80÷50=1.60.

21. 7300 grains, (weight of one pint of water)×1.42=10366 grains (weight of Nitric Acid). This equals approximately 691 grams (10366÷15).

22. (a.) Any unvarying phenomenon.

(b.) The polar quadrant of the earth's surface

~~23. 56° R. and 158° F.~~

24. a and b. Multiply by 15 432 (15 approximately)=number of grains.

c and d. Multiply by 16.231 (16 approximately)=number of minims.

Marks X refer to corrected answers.

Your rating on answers to Lecture I. is 95 *per cent.*

The abbreviations "P.," "Col." and Par.," are used to indicate "page," "column," and "paragraph," respectively.

In rating the answers, your *general understanding of the subjects* and the *appearance of your paper*, are also taken into consideration.

☞ The above questions should be *carefully reviewed* upon receipt of corrections. If questions to any other Lectures remain unanswered, please send them in at once.

THE DIRECTOR.

Always continue to answer in the regular order without waiting for delayed observations. Corrections are always forwarded as promptly as possible.

☞ NOTICE.—Do not fail to write your name, full address and CLASS page 627, at the TOP of the first page of your answers. In all correspondence the CLASS page must be stated in order to insure prompt attention.

Heat.

The subject of heat is one of great importance to pharmacy, because only by the right use of this agent can we perform successfully many of the more important operations involved in the preparation and dispensing of medicines. But in order to understand its proper management, it is important to know something of its nature and its laws. Only such a brief treatment of the subject will be given here, however, as will have important bearings on the practice of pharmacy.

Heat was formerly regarded as matter, and was classed along with light, electricity and magnetism, as "imponderable matter," in distinction from ordinary matter, which is ponderable, or capable of being weighed. But this view is now known to be erroneous; heat, light, electricity and magnetism are all modes of motion, and heat may be defined as *that mode of motion which is capable of producing in us the sensation of warmth.*

Every mass of matter is supposed to be made up of very minute particles called *molecules;* these molecules are not in absolute contact with each other, even in the most compact matter, but are separated from each other by distances varying under different circumstances, and in different states of the same substance; moreover, they are in a state of vibration, and this vibration it is that gives rise to the phenomenon we call *heat.* When the vibration is slow the body is said to be cold, or to have a low temperature; when rapid it is said to be hot, or have a high temperature. As there are no bodies without molecular vibration, there can be none that are absolutely without heat, and the terms heat and cold, therefore, are only relative, expressing different degrees of molecular vibration.

It is a great general law that masses *expand* from an *increase*, and *contract* by a *decrease*, in their temperature.

We can easily understand how this must be so, when we remember that a number of molecules vibrating with great intensity will describe longer distances and require more room than the same number of molecules vibrating with less intensity, and therefore describing shorter distances.

Matter exists in three states, that of a *solid*, *liquid*, or *gas*. These different states depend upon the relative freedom of movement of the molecules.

In *solids* the molecular attraction is so much stronger than the repellant force due to the molecular vibration, that the molecules are not easily displaced when external force is exerted upon them; in other words, the solid condition is due to the preponderance of the force of molecular attraction, over the opposing force of heat or molecular vibration.

In a *liquid* the two forces nearly balance each other; the molecules not being firmly held in the embrace of each other's attraction glide readily over one another, and liquids, therefore, readily take the shape of the containing vessel.

In a *gas* the molecules are so far apart that they are wholly unrestrained by molecular attraction and free to obey the repellant force of heat; therefore, gases tend to expand indefinitely. If restrained, they exert pressure on the walls of the containing vessel, and this pressure is supposed to be due to the impact of the moving molecules. If the walls of the vessel are unyielding, the elastic molecules rebound without losing their energy; if, however, they yield, the molecules lose a portion of their moving power, and so the well-known fact of cooling by expansion is accounted for.

Heat may be transferred from one body to another, in three different ways:

1. By conduction.
2. By convection.
3. By radiation.

(1) When one end of a bar of iron is placed in the fire the heat travels from molecule to molecule up the bar to the other end; this is called conduction. Different kinds of matter, or the same kinds in different states, conduct heat with different degrees of facility. Gases are worse conductors than liquids and solids, because their molecules, being farther apart, can communicate their motion less rapidly to each other than in liquids or solids.

(2) When heat is applied to the bottom of a vessel containing a liquid, the layer next to the bottom expands, and, being lighter, rises to the surface and a cooler layer takes its place, which in turn is heated, creating ascending and descending currents in the liquid, which result in the heating of the entire mass. This process is called *convection.* Gases may be heated in this way, a draft in a chimney is created by a fire in the same way, and it is chiefly by this means that the atmosphere is heated by the sun's rays. But it is obvious that solids, whose molecules are strongly held by the force of molecular attraction, cannot be heated by this means.

(3) The earth heated by the sun's rays, or a room heated by a grate fire, are examples of radiation. Heat is found to travel through space with the velocity of about 186,000 miles per second, and it is found, moreover, that air is not the medium that conveys it, since it is radiated with equal facility through space devoid of air, and it is incredible that air should fill the entire space between the earth and sun.

The Ether.—As we cannot picture to ourselves a force existing apart from matter, we cannot conceive of heat coming from the sun to the earth through an absolute vacuum. Matter of some kind must be the vehicle of the force. Hence the hypothesis of the *ether*, a substance of exceeding tenuity, but highly elastic, which not only fills the spaces between the heavenly bodies, but also those between the molecules of all substances. It is along this that the heat is supposed to be propagated in waves by the molecular vibrations of the heated body, much as sound is propagated in waves through the air by a sounding body, or ripples on the surface of a pond by a stone thrown into it. The ether waves set in motion by the rapidly-vibrating molecules of a hot body can in turn heat a cooler surface on which they impinge, by setting its molecules into more rapid vibration, as, for instance, the sun's rays heat the earth.

The waves that traverse the ether are not all precisely alike. Their effects are quite different in many respects, although the only physical difference between the waves themselves seems to be one of wave length. Three kinds are distinguished — dark heat waves, light waves and actinic waves. The first have the longest wave length, possess heating power but do not affect our sense of sight; the second are shorter, affect our sense of sight, and produce also heating and chemical effects; and the third are shorter still, do not affect our sight, possess little heating power, but produce chemical effects.

Heat—(Continued).

LATENT HEAT.

From the fact that the temperature of a substance ceases to rise while it is melting, even though heat still be applied to it, we readily see that much heat must disappear in the process. This is said to become *latent*. *Latent heat differs physically from free or sensible heat, in that its presence cannot be determined by the senses or by the thermometer.*

When, however, certain chemical actions take place, or the state of aggregation changes from a *gaseous* substance to a *liquid*, or from a liquid to a *solid*, then the *latent* heat so-called is rendered *sensible.*

Place, for example, one pound of water in a vessel over a source of heat where the temperature is constant and where it will increase the temperature of the water 10 degrees in one minute. Now remove this vessel and substitute one containing a pound of ice, having a temperature below 32°. The temperature will rise to 32° as indicated by a thermometer, and will remain at that point a trifle over 14 minutes, at the end of which time all the ice will be found to have melted. The amount of heat received in this time would have been sufficient to raise the temperature of the water: $14\times10°=140°$ (in reality 142°), yet the temperature of the water resulting from the melting of the ice is only 32°. This amount of heat, 142°, has then been rendered *latent.*

If the vessel now remain exposed to the same constant source of heat for 18 minutes, it will have attained the boiling point: $18\times10°=180°$, $180+32=212°$.

By continuing the heat until all the water has evaporated (passed into steam), it is found that it will require 96¾ minutes, or $5\frac{37}{100}$ times as long as it required to raise it from 32° to 212°, and yet the temperature of the steam has at no time exceeded 212°. All this amount of heat, viz., $5.375\times180°=967.5°$, or nearly 1,000 degrees has been rendered latent.

By conducting the steam in the above experiment through glass tubing into a vessel containing 5½ pounds of water at 32°, the temperature of the water will gradually rise until it reaches the boiling point (212°), having been increased 180° by the condensation of the steam. Its weight will also be found to be 6½ pounds, showing that the one pound of water has been recovered by the condensation of one pound of steam.

The heating power of steam, or that which renders it so superior to boiling water as a heating agent, is due to the large amount of latent heat it contains, for this latent heat is not destroyed, but is rendered sensible again when the steam is in the act of *condensation.*

We may regard the particles of any body as being subject to two opposing forces—*cohesion*, which tends to draw them more closely together—and *heat*, which tends to drive them farther apart.

If the heat be *increased*, the body under its influence further expands, until at a given temperature, the particles, driven still wider apart, resolve the substance into a *liquid* state; finally in the case of many substances, the heat entirely overcomes the cohesion, and the particles fly apart in the form of *vapor.* When the source of heat is removed, and that already acquired by the substance has been imparted to surrounding objects, cohesion again comes into play and the substance assumes the *liquid* or the *solid* state.

PHARMACEUTICAL USES OF HEAT.

The sources of heat are various. One great source of heat is the sun, and some is derived from the earth's interior, but most of that of terrestrial origin comes from the transformation of other forms of energy; as, for instance, mechanical energy is converted into heat when a cannon ball strikes a target, or when the brakes are applied to a moving train.

Electricity is converted into heat when a strong current is made to pass through an inadequate conductor, as in the various forms of the electric light; and chemical energy is converted into heat in all cases of combustion, as when a match is kindled, or coal is burned. In the practice of pharmacy *combustion* is the most important source of heat. The substances used are the ordinary combustible materials, such as coal, wood, alcohol, kerosene, and coal-gas. The best, perhaps, is coal-gas, if it can be afforded, as it is convenient, safe, cleanly, and heat of almost any required degree of intensity can be obtained by means of it.

The best gas stoves are so constructed as to yield a nearly colorless flame, and one whose heat is very intense. These objects are accomplished by admitting a stream of air in such a manner as to cause it to mingle with the gas below the flame, making the combustion more rapid and complete.

A knowledge of the leading facts in regard to the conduction of heat is of much practical importance to the pharmacist.

Solid substances differ very widely from each other in their power of conductivity. The metals on the whole are much better conductors than the non-metals, but even metals differ widely among themselves. If the conducting power of silver (the best conductor known) be taken as 100, that of copper will be 73.6; tin, 14.5; iron, 11.9; lead, 8.5; platinum, 8.4, and bismuth, 1 8. Silver is, therefore, nearly sixty times as good a conductor as bismuth, but bismuth is eighteen times as good a conductor as porcelain, and the latter is a far better conductor than wood. On a cold day, in an unheated room, the different objects in the room are practically at the same temperature, but the handle of the poker feels cold, the marble mantel less so, a chair-back less so still, and the Brussels carpet scarcely at all cold to the touch. If the temperature be very low in the room these differences will be very decided, and yet they are due solely to the very different power these bodies have of conducting heat from the hand.

So, also, on the other hand, if a piece of iron and one of soapstone each be heated to the temperature of 100° C, the latter will seem much cooler to the touch than the former, because it is a worse conductor. For reasons like these metallic vessels that are to be subjected to high temperatures are provided with wooden or porous earthenware handles, ice is wrapped in woolen blankets to keep it from melting too rapidly, or a hot body is wrapped in similar porous material to prevent it from parting with its heat too rapidly; and for this reason houses are built of wood or other non-conducting material, woolen used for winter clothing, and arctic mammals are provided by nature with a covering of thick, soft fur.

For further information upon the subject of "Heat" students may refer to Trowbridge's "Essentials of Physics," and Parrish's or Remington's "Pharmacy."

Desiccation.

Crude substances obtained from the vegetable and animal kingdoms are usually dried, or *desiccated*, before they can be utilized in medicine.

As is well known, all organic matter contains water which at a favorable temperature (from 90° to 120° F.) facilitates changes in the principles usually present, resulting in decomposition of the substance, and frequently impairing its value.

Albumen, gum, sugar, starch, etc., are substances found in vegetable drugs, which with moisture and exposure to warm temperatures undergo putrefactive or fermentative changes. The presence of moisture and vegetable acids similarly causes the formation of fungoid growth (mold); which is detrimental to the substance, frequently diminishing its active principles, and hence impairing its medicinal value.

In depriving the substance of its moisture, by evaporation of the water, we therefore remove the principal cause of decomposition, *i. e.*, water. This process is termed *drying*.

The most favorable temperature for decomposition is 90° to 100° F.; at 120° F. albumen coagulates; at 140° F. and above, most of the principles promoting change in organic substances become so modified by the heat as to permit no deterioration of the drugs, which are then designated as cured.

Since a temperature above 90° F. cannot usually be obtained in temperate climates from the sun's rays alone, the drying of the drugs is generally effected by *artificial* heat, such as hot air or steam. Substances, previous to being dried, are, in the case of fleshy roots or bulbs, sliced; barks are deprived of the outer cork, fruits freed from the rind, etc., while leaves, seeds and flowers are generally dried whole. The procedure is generally very simple, and consists in exposing the substance properly prepared in shallow trays to hot air, or barks may be nicely dried in a barrel, having a net at both ends, and placed upright, so that a draft of hot air may pass through the contents.

On a large scale, *drying-rooms* are used, heated by steam and furnished with large shelves upon which the trays containing the substance to be dried are placed. It is necessary to admit fresh air in such drying closets at the bottom and provide an exit at the top for the escape of the air, which has become saturated with the moisture of the drugs in the form of vapor. Unless so arranged that a current of air transverses the drying-room, acting as a carrying agent of the water, the evaporation will cease as soon as the air confined in the chamber becomes saturated with vapor.

The *rate of evaporation* is governed to a great extent by the following circumstances:

(1) The percentage of moisture in the air, and the rapidity with which the air in contact with the substance is removed.

(2) The state of division of the substance, or physical condition, and its affinity for water.

Thus, compact drugs, such as aloes, guarana, and opium, must be exposed to heat for a longer period than more porous drugs, for example, hop and senna.

Sodium carbonate is more quickly dried than alum, a substance equally compact, owing to the fact that the former does not possess so great an affinity for water as the alum.

The degree of temperature at which vegetable drugs are dried, varies with the character of the drug. While the maximum heat considered safe (140° F.) may be applied to most roots, *i. e.*, taraxacum, inula, senega, gentian, etc., a temperature of 120° F. should not be exceeded for herbs containing delicate principles, such as belladonna, hyoscyamus, digitalis, etc.

Parts of plants containing aromatic, or other volatile constituents, such as the different mints, wild cherry bark, and the various gum resins, asafœtida, myrrh, etc., should be dried very carefully, lest their active principles should escape, thus rendering the drug more or less inert.

Substances of the class named are frequently dried spontaneously by exposure to a warm atmosphere. It is quite as important that the temperature at which the drug is dried be not so high as to volatilize any fugitive principle—in other words, that it be properly dried—as that the substance shall contain no moisture, that is, be *thoroughly* dried.

The quantity of water or moisture in some vegetable substances when fresh, is quite considerable. Thus certain leaves lose eight-ninths of their weight in being dried; fleshy roots and bulbs nearly as much; barks and similar parts of plants of close structure much less. Since, however, drugs are rarely used in the fresh state, this loss is immaterial, although it is readily seen that such drugs, carefully dried, must be correspondingly stronger than the same drugs containing this quantity of water.

PRESERVATION.

The preservation of vegetable drugs is highly important, and deserves more attention than it usually receives. The more fleshy parts of plants, for instance, roots of rhubarb, jalap, colchicum, columbo, etc., as found in pharmacies, are frequently worthless.

This condition is generally due either to the fact that the root was not properly dried or "cured" when purchased, or that it had commenced to deteriorate when procured from the dealer. To remedy this condition, the pharmacist should select only whole drugs of choice quality, and if upon examination they should prove to be not thoroughly dried, steps should be taken at once to effectually free them from moisture by a proper application of heat. This can be readily accomplished by improvising a simple arrangement as outlined above.

Specimens of drugs of excellent quality, frequently deteriorate for no other reason than that they are not perfectly dry; rhubarb, and nearly all fleshy roots, easily become worm-eaten when in this moist condition, especially if stored in a damp place, where, owing to their hygroscopic qualities, they rapidly absorb moisture from the atmosphere. All vegetable drugs, especially when of this nature, must be protected from damp air. Barks, flowers and leaves do not as a rule deteriorate rapidly, though seeds and fruits undergo changes even when carefully preserved, and thus necessitate replenishment of stock annually.

Comminution.—Garbling.

GRINDING.

The vegetable substances used in medicine may be generalized from the standpoint of comminution — the process of reducing to small particles — into, *fibrous, cellular, stony, horny* (*flexible*) *and fragile or conchoidal.*

Fibrous drugs embrace most of the roots and barks.

Roots of fibrous texture, such as glycyrrhiza, stillingia, sarsaparilla, etc., should be cut transversely into pieces of about half an inch long and dried until crisp, when they can easily be reduced to coarse powder in an iron mortar or in a drug-mill. Barks may be treated in the same manner.

Cellular drugs comprise chiefly herbs, flowers and leaves.

These parts of the plant are generally very light and of loose texture, it being almost impossible to reduce them to a uniform coarse powder. Owing to the slight resistance they present, their reduction in a mill is very difficult, the mortar being best adapted for this purpose.

Small quantities to be used in the preparation of tinctures, etc., are best comminuted in an iron mortar by first moistening the drug with a little of the menstruum, when it can be quickly reduced to a moderately coarse power.

Stony drugs comprise only a few tubers, aconite and jalap and some roots, among which stone root (collinsonia) and gelsemium are conspicuous.

These drugs rarely appear in the market whole, since they can only be reduced to powder in mills worked by steam power.

Some of these drugs possess poisonous properties, and great care is therefore necessary in grinding them.

Horny or Flexible drugs include mostly seeds and low forms of organization, such as ergot and galls.

These drugs are very difficult to powder; owing to their flexible nature, they pass between the grinding plates of a mill, unless it be a powerful one, intact. The best work can be effected by pounding them in a large iron mortar (see mortars), the constant concussion having the best effect upon the shell of the seed.

Nux vomica is especially difficult to reduce to powder, but when steamed for a few hours and then dried, it may be powdered with comparative ease.

By *Fragile* drugs is meant such as break readily and present a conchoidal fracture. They embrace most of the gums, resins and natural extracts, such as acacia, guaiac and aloes respectively. These are easily and quickly reduced to powder in a large Wedgewood mortar with flat bottom.

This class of drugs usually require drying, as they contain a large percentage of water.

GARBLING.

Vegetable substances should always be carefully examined for the detection of possible adulterations, either intentional or accidental.

The most common form of admixture in parts of plants, such as roots and leaves, are portions of the stems, which being usually woody and inert, detract from the quality of the drug, and should invariably be rejected.

Cimicifuga, leptranda, ipecac and gelsemium are specimens which in the whole or crude state are frequently mixed with considerable quantities of inert stem.

Dirt, especially earth adhering to the fibers, is met with generally in hydrastis, leptandra and valerian. These drugs should always be procured when possible, "washed."

Leaves are frequently accompanied by stems from which they must be separated, unless the stems possess medicinal properties and are recognized in the Pharmacopœia. Withered specimens, however, are practically inert and should be rejected.

Flowers are clean and easily preserved parts of plants; this is true also of *barks*, which must, however, be gathered at the proper season and be free from inert cork and tough fiber.

Sometimes the admixture is *intentional*, when it is more difficult to detect it, since specimens possessing nearly similar physical properties and similar also in appearance, are used for adulteration.

The most striking illustration of this is in taraxacum, large quantities of which are frequently found to consist entirely of chicory (cichorium intybus); also in the substitution of German valerian for English, which latter possesses greater medicinal strength, and is therefore more highly prized.

More attention should be paid by pharmacists to the *quality* of drugs, since adulteration and even sophistication can be detected in crude substances usually without much labor.

Adulteration in its usual forms of admixture, dirt and inert portions of plants, must be avoided to obtain preparations that are permanent and possess definite medicinal activity. The presence of earthy impurities in a vegetable drug interferes with the elegant appearance and permanency of the preparation made from it, for the reason that such impurities are to some extent soluble in the menstrua ordinarily used, being carried with it in the extraction, and subsequently precipitate in the finished product. *Inert and sophisticated* specimens are of course objectionable, because their use detracts from the strength of the preparations.

Unfortunately, crude drugs are not procured in a form which admits of ready examination, since they are generally put up for the market in pressed packages. Large specimens of these drugs must be crushed before they can be pressed, and this renders their identification exceedingly difficult.

While the practice undoubtedly presents some advantages in that the drugs are thus better preserved, it nevertheless prevents the purchaser from selecting specimens of good quality only.

Herbs and leaves, when procured in small packages, should be examined by opening one or more of these in each large package, so that the quality may be noted. Preference should always be given to drugs in *bulk*, since they admit of ready examination.

Comminution—(Continued).

POWDERING.

All substances are more readily acted upon by solvents when reduced to powder, for the reason that in this form the greatest surface is presented to the solvent action of the liquid.

Vegetable drugs consisting of parts of plants are composed of cellular tissue in which the active principles are found. The medicinal constituents, alkaloids, neutral principles, resins or acids, are in solution in the sap flowing through the cells which make up the tissues, and, upon evaporation of the water in the process of drying, are left in these cells in a more or less soluble condition. When, therefore, it is desired to obtain these principles in solution, it is necessary to rupture the cell-walls, so that the solvent action of the liquid used in the extraction (menstruum) may exercise its full power.

It is obvious, therefore, that the degree of fineness of a powder of any given drug should be proportioned to the size of the cells which make up its structure.

In vegetable drugs the cell-walls are usually a sort of septum or membrane which permits solution of the principles they contain by the entrance and outflow of the liquid charged with the constituents of the drug. This phenomenon is termed *osmosis*, or, when applied to the separation of different substances, dialysis. With the aid of this property, peculiar to most organic substances, solution of the constituents of a plant may often be effected without reducing the part to a fineness corresponding to the size of the cells. This is the case whenever the active principles are soluble in water. It so happens, however, that the cell walls do not acquire the power of osmosis until they have been restored to the condition they had previous to drying, or, in other words, until they have absorbed water to saturation.

On the other hand, the active principles of a great many drugs, especially alkaloids, resins and oleo-resins, are scarcely soluble in water, and such menstrua must be used for extraction (alcohol), as will readily dissolve them, water being therefore excluded. It is necessary with this class of substances to reduce them to very fine powder for extraction, since only the *solvent* action of the liquid can be relied upon, the exhaustion of the drug not being favored by *osmosis* through the cell walls.

A general rule is, therefore: *When alcohol, or strongly alcoholic menstrua, are used, the drug to be extracted must be in very fine powder to admit of complete exhaustion.*

For this reason, cinchona, aconite, belladonna, nux vomica, etc., are directed to be in very fine powder.

On the other hand, with drugs the active principles of which consist of acids, *i. e.*, senna, gentian, taraxacum, or other similar principles soluble in water, the fineness need not be greater than that of a *moderately coarse* powder; the water permeating the cell-walls and inducing the osmotic action, exhaustion will soon be completed.

Gum, pectin and sugar are inert substances frequently present in drugs, and since they are rendered more or less soluble by water or watery menstrua, they may retard extraction if the drug be in a very fine powder.

IMPALPABLE POWDERS.

The powdering proper of drugs is generally conducted on a large scale, since it requires expensive machinery and steam power.

The *dusting process* is that usually employed, and consists in crushing the drug by means of stones of large diameter and great weight, revolving on a base; the dust which rises during the process accumulates upon the platform placed at a height of about four feet, and is preserved. Such mills are termed "chasers."

Drugs which present a *conchoidal fracture*, and are more brittle, are easily powdered on a smaller scale in a "potmill," which consists of a hollow ball of any desired dimensions, revolving upon an axis. In the interior of this hollow ball are placed two or more cannon balls (through a convenient opening which may be closed with a large flat cork). The weight and triturating action of the cannon balls reduces the substance quickly to a very fine powder.

In the pharmacy drugs are usually powdered in a *mortar*. A large iron mortar placed upon a stand fixed in the ground and provided with a spring to the pestle, does effective work. The spring is a great help, as it not only guides the pestle to the proper place—the bottom of the mortar—and thus prevents the disagreeable clanking sound, but also because it raises the pestle after the stroke, and thus saves over half the labor otherwise required. A hickory spring about six feet long and three inches wide at the base, that gradually tapers in width and thickness to about one inch at the end, is firmly attached to the rafter of the ceiling about one foot from the base of the spring, which is blocked up four inches or less. A stout cord is now attached to the small end of the spring and fastened to the pestle handle (which should be provided with an eyelet). The cord must be of such length that when the spring is bent to its fullest capacity the pestle will reach the bottom of the mortar. The pestle is made to descend by the force of the hand, but is carried upward by the spring when the pressure of the hand is relaxed. Cinchona, ergot, opium, etc., may be powdered by means of this inexpensive and labor-saving device. Squills, gums and gum-resins when chilled may be reduced to very fine powder without difficulty; it is necessary, however, in order to preserve them in the powdered form and prevent "caking," to add a small quantity of some inert matter, such as milk-sugar. This class of powders must be stored in tightly-stoppered bottles, and in a cool, dry place.

SIFTING.

In powdering a vegetable substance we measure the degree of comminution by sifting.

For impalpable powders, bolting cloth is mostly used, while in the pharmacy sieves are constructed of iron wire, brass wire and of hair cloth, for coarse, fine, and very fine powders respectively.

The standard adopted in the U. S. P., 1880, for these various degrees of fineness, expressed in the number of meshes to one linear inch, is as follows:

A coarse powder = No. 20 powder.
A moderately coarse powder = No. 40 powder.
A moderately fine powder = No. 50 powder.
A fine powder = No. 60 powder.
A very fine powder = No. 80 powder.

Boiling.

Water, on attaining the temperature of 212°F., enters into a state of ebullition; a large number of bubbles of steam are produced in the part of the vessel exposed to the heat, which rise through the liquid, violently agitating it as they burst. This is termed *boiling*.

The point at which this ebullition commences is that at which the tension of the steam becomes sufficient to overcome the pressure of the atmosphere; hence, if this pressure be increased the boiling point will be raised. Thus, the boiling point of water is 213° at 30° barometer; when the mercury column in the barometer falls, indicating diminished pressure of the air, the water boils at a lower temperature.

The determination of the boiling point of liquids is very important, since boiling discloses a physical property usually dependent upon the chemical constitution of the liquid, and therefore frequently is an index to its identity, strength or purity.

It consists in bringing the liquid to boiling in a test tube or other proper vessel, then inserting a bulb thermometer in the vapor just above the surface of the liquid for a few minutes; the degree of heat indicated by the mercury column after it has become stationary is the boiling point of the liquid.

It is important to note that the material of the vessel and its thickness, together with the condition of its interior surface, influence the temperature of the boiling point; thus, water contained in a thick porcelain dish will boil at 215°; in a glass vessel, which has just previously contained sulphuric acid, at 218°, etc. Owing to this lack of uniformity, it is better to take the temperature of the escaping vapor immediately above the liquid rather than that of the liquid itself, although if test-tubes be used the boiling point of the liquid itself may be taken with results that closely approximate correctness.

In vessels composed of materials which are good conductors of heat, *e. g.*, metals, a liquid can be brought to the boiling point much more quickly than in porcelain, earthen or glass vessels, which are poor conductors of heat. Heat is more readily absorbed by substances presenting dark and rough surfaces than by those having light-colored and smooth exteriors. A liquid is therefore more quickly heated in a vessel of unpolished metal than in one having a smooth or brightly-polished surface. Another important effect of heat upon substances is to cause them to expand. The expansion is greatest in gases, and least in solids.

Imperfect conduction, in conjunction with expansion produced by the sudden application of heat, is the well-known cause of the breaking of glass and other vessels of similarly fragile material used in the pharmacy.

Glass flasks and earthenware vessels, such as porcelain evaporating dishes, are to be handled very carefully for this reason. Such vessels are usually made very thin in order to diminish the liability to breakage from sudden and unequal expansion. Heat readily passes through the walls of a thin glass vessel, and no great strain is produced upon the glass by unequal expansion; also the thinness of the vessel facilitates the rapid and equal heating of the contents. But these advantages are not gained without the corresponding disadvantage of rendering the vessels more liable to be broken by careless handling.

Test-tubes filled with cold water, owing to the exceeding thinness of the glass, may be placed directly in the flame without much danger of breakage; but larger glass vessels, like Florence flasks and beaker glasses, must be heated with more caution when filled with cold liquids, owing to the greater thickness of the material. Porcelain and enameled vessels have a decided advantage over glass vessels, since they are more substantial, not so easily fractured by sudden changes of temperature, and they withstand the action of acids quite as well as glass. They are frequently "cracked," however, but this is generally the result of attempting to heat the vessel first and then pouring into it a cold substance, a thing which should never be done under any circumstances.

It is often desirable to use hot water in cleaning glass bottles, graduated measures, or other glass dishes. This operation, unless conducted intelligently, is almost certain to result in disaster. A simple and perfectly safe method is first to thoroughly wet the interior walls of the vessel with cold water, then boiling hot water may be poured into it without danger of fracture.

Fragile vessels, such as glass flasks and beakers, should never be placed when hot in contact with good conductors, such as counter or table tops made of marble or metal, since the rapid abstraction of heat from a portion of the glass, and not from the rest, will produce a strain which will almost invariably result in fracture.

The tops of tables used in the laboratory should therefore be made of wood, or some other non-conducting material, or the hot glass dish should be set down on paper, cloth, or some other soft, non-conducting substance.

In boiling without pressure in an open vessel the temperature of a liquid can never be raised above its boiling point, as all the surplus heat received is employed in evaporating the water, except under the conditions above noted. When a closed vessel is employed, the pressure may be increased and a much higher temperature attained.

Advantage is taken of this fact in pharmacy, when boiling water is desired quickly, as, for example, in making decoctions or infusions. The vessel used for heating the water in such cases should be covered.

Steam.—One cubic inch of water by boiling is converted into about 1,700 cubic inches, or nearly one cubic foot, of steam, and in the mere conversion of a cubic inch of water at 212° F. into steam at the same temperature an amount of force is exerted which is equivalent to lifting about 27,000 pounds one foot high.

Steam, as a source of heat, contains 967.5° F. of latent heat. By contact with a cold surface it is condensed to the liquid form and this heat is given out. Theoretically, steam in the act of condensing will raise the temperature of nearly ten times its weight of water 100° F. Twenty pounds of steam condensed in 200 pounds of water at 112° F. will raise the temperature of the water to 212° if no loss is sustained.

Evaporation.

EVAPORATION.

The general principles or laws governing evaporation are stated under the subject of Desiccation.

Evaporation is a term generally applied in pharmacy to the process by which a solution is reduced in volume or concentrated by means of heat.

The concentration is due to the vaporization of the liquid portion; this is hastened by *stirring*, which facilitates the evaporation of liquids for two reasons:

(1) A larger surface is thereby presented to the action of the heat and also to the action of the air.

The greater the extent of the surface the greater and more rapid the rate of evaporation.

The compounds of iron with vegetable acids (citrate, tartrate, etc., for example), are easily decomposed by a heat exceeding 150° F. Owing to the *viscid* character of the solutions from which they are prepared (see liq. ferri citratis, U. S. P.) complete evaporation of the water contained in the solutions cannot be attained by the usual method of evaporation in a vessel or dish without the application of a degree of heat (above 150°) which would decompose the salts, but by spreading the solution in thin layers on glass plates, so as to obtain a greater extent of *surface*, evaporation takes place rapidly at a comparatively low temperature (120°).

Such salts are termed *scaled*.

(2) *Agitation favors evaporation by renewing the air in contact with the surface of the liquid.*

The air above a vaporizable liquid soon becomes charged with vapor, and the evaporating process goes on slowly unless the air be renewed, and the more rapid the removal of the saturated air the more rapid will be the evaporation.

Partly on this principle and partly on the principle that the boiling point of liquids is lowered as the atmospheric pressure on the surface is reduced, the process of *evaporation in vacuo* is performed. While under the ordinary atmospheric pressure of 15 lbs. to the square inch, water boils at 212° F., when heated in a closed vessel and the air above its surface exhausted, it boils at 80° or 90° F. below the usual temperature, or about 132° F. The process also has the advantage that it permits rapid evaporation in a comparatively low temperature.

The following considerations should also be observed in conducting the process of evaporation:

The evaporating vessel (dish) must be *shallow*, so as to present as great a surface as possible both to the heat and to the air which carries off the vapor.

The evaporating dishes should be made of material from which the product may be removed without contamination. For this reason porcelain or enamcled dishes are to be preferred to those of soft metal, such as copper.

The heat should be carefully regulated at its source, to avoid overheating the substance.

Vegetable principles are much more easily impaired or destroyed by heat than *inorganic* or mineral substances; these latter when in solution do not require any special precaution, since they may be subjected to great heat without undergoing decomposition.

In evaporating a substance the highest degree of temperature to which it may be exposed without injury must be known, and the source of heat employed accordingly. The following media, the temperature of which can easily be regulated, are therefore employed as the sources of heat for evaporation.

BATHS.

Water Bath.—The principle upon which the water bath is constructed is, that all matter gives out heat to surrounding matter; water, therefore, when heated, communicates its heat to any substance with which it comes in contact, until both have the same temperature.

It consists of two vessels—one fitting within the other in such a manner that a space of greater or less extent is left between them. This space is nearly filled with water, and the substance to be evaporated is placed in the inner vessel. It is evident that with such an arrangement the liquid in the inner vessel cannot be heated above the temperature of 212° F., and if it be a substance liable to decomposition at any higher temperature, the process becomes a safeguard against such an occurrence. The method also admits of very gradual and even application of heat.

Steam Bath.—The use of steam heat in certain forms of evaporation is a great convenience, since it affords a *range* of temperature proportionate to its *pressure*, or to the pressure which the vessel is calculated to sustain.

The vessel or apparatus for a steam bath consists of two pans, riveted together at the upper edge—jacketed—having an inlet-pipe to admit the steam into the space between the two pans just below the point where they were joined, and an outlet-pipe at the bottom, allowing the escape of the condensed steam or water. Both pipes must be provided with stop-cocks to regulate respectively the inflow and escape of the steam.

Steam may also be employed for heating purposes, without being confined, called "live steam," by placing the vessel containing the substance to be heated loosely into another vessel so that it rests upon the rim of the latter, into which the steam is admitted.

Saline Baths.—Saturated solutions of various salts, in order to be brought to the boiling point, require a greater amount of heat than does water. For example, the boiling point of a saturated solution of sodium chloride is 227°; sodium borate (borax) 222°; ammonium chloride, 237°; potassium nitrate, 240°; and sodium acetate, 256° F.

The use of these baths is indicated when it is desired to heat a substance a few degrees higher than can be done by the water bath, and also when a very regular heat is desired, since the temperature in these baths, under a uniform heat, does not change so long as the water is replenished sufficiently to hold all but a small portion of the salt in solution.

The Oil Bath.—When it is desired to heat a substance to a temperature not exceeding 500° or 600°, a bath of some fixed oil, or preferably petrolatum, answers the purpose, since they attain this temperature before their boiling point is reached.

The Glycerin Bath is likewise used, the boiling point of the glycerin being 554° F.

The Sand Bath is employed when an extreme heat is desired, but when a naked fire would not yield a constant or regular temperature.

It consists simply of a layer of dry sand placed in a shallow iron dish, in which the vessel to be heated is imbedded. A comparatively thin layer of sand will be sufficient to equalize the heat and prevent a sudden rise in the temperature, which might result in fracturing the vessel or injuring the product.

Distillation.

Distillation is the process whereby a liquid substance is obtained or separated from other substances by means of *vaporization and condensation.* The product is termed a *distillate.*

The vaporization of a liquid for the purpose of distillation must be conducted in a vessel especially constructed for distilling, termed a *still.*

The Still consists essentially of a *retort* and a *condenser.*

The former, containing the liquid to be distilled, commonly consists of a vessel rounded below and contracted into a neck above. The neck or outlet-pipe should, in order to facilitate the escape of the vapors into the condenser, gradually curve downward.

The diameter of the outlet should always bear a definite relation to the diameter of the evaporating vessel (the pan) so as to carry off the vapor as quickly as possible. The proper relation between these diameters is about one inch for the exit to six inches for the vessel proper. This rule is especially to be observed in distilling watery liquids; with alcohol or strongly alcoholic liquids it is not so essential, because they vaporize more readily and the vapor escapes more quickly.

Retorts employed in distilling acid or corrosive liquids and substances requiring a high temperature are usually made of glass.

They are either simple retorts made in one piece with only one opening at the end of the elongated neck, or furnished with a small aperture at the neck provided with a ground-glass stopper, when they are called *tubulated.* The purpose of this aperture (tubulure) is to enable the operator to introduce fresh quantities of the substance to be distilled.

In retorts not tubulated, this procedure is very difficult and inconvenient, because the liquid cannot be poured into the retort without placing it in an upright position, thus disarranging the whole apparatus. By means of a *funnel-tube* (a glass tube with a bell-shaped end) the retort can easily be filled or replenished through the tubulure.

The *Adapter* is a short tube, sufficiently wide at one end to receive the end of the still or retort, gradually tapering to a width which admits it into the neck of the receiver.

Condensation.—The vapor formed in evaporation by exposure to a cold temperature is converted into a liquid—*condensed.*

In distilling it is necessary to use artificial means for condensing the vapors, since the effect of cold air alone would be too slow and unreliable.

The Apparatus for effecting condensation is termed a *condenser.*

A condenser is a tube or coil of considerable length attached to the neck of the still, for carrying the vapor through a cold substance—usually water—and after being condensed into liquid form to convey it to the receiving vessel.

The usual forms of condensers are:

The *worm,* which consists of a coil of tubing, generally of copper or earthenware pipe, but sometimes of glass, and placed in a tub of running water, and

Liebig's Condenser, which consists of two tubes of unequal diameter, fitted one within the other, the intervening space being filled with cold water.

As in evaporation, the greater surface the vapor is exposed to, the greater is the condensation. This principle has been taken advantage of in the construction of various condensers, such as Remington's and Lloyd's.

Sublimation is the process of distillation applied to solid substances.

Substances easily volatilized, such as camphor, are obtained, or refined from their crude state, by *sublimation.*

Inorganic substances, such as iodine, sulphur, mercury, etc., are obtained in a pure form by sublimation. Mixtures of different substances or chemical compounds may often be separated by means of sublimation.

Benzoic Acid is mostly prepared artificially from urine, and then contains some foreign substances, which renders it objectionable for delicate purposes. If some of this acid be placed in a shallow evaporating dish, a piece of very thin paper or gauze placed over it, covered with another dish as completely as possible and then heated, it will be found that the acid will sublime in a *pure* form in the top vessel. Care must be taken, however, that the heat be withdrawn as soon as the acid has volatilized, because the separation depends upon a *difference* in volatility between different substances; hence the importance of temperature.

Fractional Distillation is a process for the separation, by distillation, of two or more liquids having different boiling points.

The method usually employed in this process is to insert a thermometer in the boiling liquid, and collect the distillate in different vessels, as it comes over at different temperatures. The separation may also be effected by condensing the vapors in a series of receivers exposed to different temperatures.

In pharmacy, mixtures of ether, alcohol and water are thus separated, owing to the great difference in their boiling points (or temperature for vaporization) and the corresponding difference in temperature necessary for condensation. In the arts fractional distillation is largely applied to coal-tar, oils, petroleum, etc.

In conducting the process of distillation the following general rules should be observed:

The apparatus must be vapor-tight. Since the object of the operation is to recover the volatile portion, any loss of vapor will necessarily reduce the quantity of the product—the distillate. In the ordinary pharmaceutical stills, constructed of tin or copper, this is frequently difficult, since they usually consist of two halves to facilitate emptying the contents. The flanges of these two parts of the still should be substantially made and fit upon each other perfectly true, so that when screwed together they will be tight.

In the distillation of liquids, in addition to the above rule, the following details should be remembered:

(1). The condensation must be complete. There must be an abundant supply of cold water around the condensing pipe, sufficient to condense all the vapor; otherwise loss will result. The water surrounding the vapor in the condenser should always be renewed as soon as it becomes warm.

(2). In heating the contents of the still, care must be taken that the increase of temperature be gradual. The still above described is usually heated by a water-bath, by which the heat may easily be regulated and accidents from over-heating prevented.

(3). The still should never be filled more than two-thirds full of the liquid to be distilled, since otherwise it is liable to foam and boil over.

For full description of apparatus employed in distillation see Remington's or Parrish's Practice.

Heat—(Concluded).

Fusion.—The melting or fusing point of a substance is the temperature at which it changes from the solid to the liquid condition. The fusing point is very different for different substances, some liquefying at a very low, others at a very high temperature; and others still, like carbon, resist the highest temperature we are able to command. These are said to be *infusible*.

The temperature at which fusion commences is constant for any substance so long as the pressure remains constant; and from the time that fusion commences the temperature remains stationary until the whole of the substance is melted.

Some substances, as iron and wax, soften gradually before they actually fuse, while others, as lead and copper, melt without softening. In the case of iron, great advantage is taken of this property, as by means of it the blacksmith can weld different pieces together, or mould them into any desired shape.

In the preparation of ointments, plasters, and similar preparations consisting of easily fusible substances liable to injury by heat, this law has a practical bearing, viz., that no injury by exposure of the substance to heat can result until the fusion or liquefaction is complete.

Thus, in melting a substance from which a cerate is composed, the vessel may be exposed to considerable heat without injury to the substance, so long as any portion remains unmelted. As soon as fusion is completed, however, the heat must be carefully regulated (or its source removed), since the temperature will now steadily rise if heat be applied.

The kind of vessels used in the process of fusion depends upon the chemical nature of the substance to be melted, and the degree of heat necessary for its liquefaction.

In *pharmacy* the process of fusion is mostly applied to the production of cerates, ointments, plasters and similar preparations composed of substances requiring a temperature usually below 212°.

For these the water-bath is the best means of applying the heat. The vessel containing the substances to be melted may be either metallic, as copper, or, preferably, glazed earthenware.

The melting point of *fats* is determined by immersing a small portion of the substance in a test-tube of boiling water, in which a thermometer is placed, until completely melted. It is then allowed to cool, and the degree of temperature at which the substance commences to congeal, as indicated by the thermometer, is the *melting point*.

For the melting points of officinal fats, see U. S. P.

Deliquescence is a property which causes certain substances to absorb moisture from the air and gradually pass into the liquid condition.

Potassium carbonate is an example of a substance which possesses this property in a high degree. Substances of this kind should be carefully protected from the atmosphere in well-covered cans or tightly-stoppered bottles, and, if possible, in a cool, dry place.

The term *hygroscopic* is applied to solids which attract moisture, but which, owing to their inferior solubility, do not pass into the liquid condition. Examples of this kind occur in many powdered extracts.

Among the important effects of heat are its *chemical* effects.

Heat causes a vibratory motion of the molecules of a compound substance. When the temperature is increased this motion may at last become so great as to cause the constituent elements to move out of the spheres of their atomic attractions, and thus cause decomposition of the substance.

Heat is one of the most useful agents for bringing about decomposition. Being a repellant force, and the repellant power increasing as the temperature rises, it is probable that if we could command a sufficiently high temperature even the most stable compounds would be separated into their elements.

The principal chemical effects of heat are the following:

Calcination, which consists in driving off volatile matter from solid substances by heat. The residue is usually left in the form of a friable powder, which is said to be *calcined*.

Calcination is used chiefly to expel carbon dioxide from its compounds (the carbonates). For example, when calcium and magnesium carbonates are strongly heated, carbon dioxide and water escape into the atmosphere, and lime and magnesia, respectively, are left behind.

Sublimation, similarly to calcination is a process for separating a volatile solid substance from one not volatile, but differs from it in that the volatile portion is the product desired.

Examples: Camphor, sulphur, etc., are sublimed to free them from fixed impurities.

Carbonization is the process of reducing to coal by heating organic substances until all volatile matter is expelled, air being excluded.

Wood and animal-charcoal are illustrations.

Torrifaction or "Roasting," consists in scorching or parching organic substances to change or modify certain constituents without impairing the principles of the most value in the substance so treated.

The roasting of coffee is a familiar example in which the undesirable constituents are so modified as to give aroma to the berry, without deterioration of the active principles, caffeine and caffeotannic acid.

Ignition is a term applied to the method of testing chemical substances by heating them to redness according to Pharmacopœial requirements.

Incineration or "Burning," is the union of oxygen with the elements of an organic substance by the application of heat resulting in the production of flame and residue, termed *ash*.

Efflorescence.—Some crystalline substances that contain water of crystallization, such, for instance, as common washing soda, lose their water on mere exposure to the air, and the salt falls to powder, or at least its crystals become covered with a white powder. This phenomenon is called *efflorescence*. It may be prevented by keeping the salts in air-tight cans, or tightly stoppered bottles.

Deflagration is a process seldom employed in pharmacy. It consists in heating one inorganic substance with another capable of yielding oxygen, resulting in decomposition and the formation of a new compound.

Questions on Lecture I.—Series 8, 1890.

☞Make Definitions Brief and in Your Own Language.

1. State the difference between a Pharmacopœia and a Dispensatory.
2. Of what Sciences is a knowledge necessary in the theoretical consideration of Pharmacy?
3. Do you consider Pharmacy a science? State reasons for answer.
4. How often and why is the United States Pharmacopœia revised?
5. What is meant by Metrology, and in what different *ways* may quantities be determined?
6. Mention some tests to determine the accuracy of a balance.
7. What causes exercise a variance in the size of drops of a liquid?
8. What is the difference in *grains* between the Avoirdupois and Troy Ounce; also between the Pounds?
9. How many Troy Ounces in an Avoirdupois Pound?
10. What Systems of Measures of *capacity* are in use in the U. S.?
11. How many *minims* in a U. S. Fluid Ounce? How many in a Pint?
12. Give the *weight* of a minim of water and the *measure* of a Grain of Water.
13. Calculate the *weight* of a Fluid Ounce of Sulphuric Acid and the *measure* of a Troy ounce of it.
14. At what temperature does the U. S. P. direct the determination of Specific Gravity?
15. Calculate the *weight* of a Pint and the measure of a Troy pound of each of the following: Alcohol, Nitric Acid and Chloroform.
16. State the number of drops in one fluid dram of Tincture of Chloride of Iron dropped from a one ounce vial. 120
17. Give a rule for determining the *weight* of any volume of a specified substance.
18. How much Drug would it require to make one Pint of a 20 *per cent.* Tincture, having a specific gravity of 0.90, for example?
19. Give a Rule to determine the volume of any liquid whose *weight* is known.
20. If a 50 gram bottle filled with a liquid weighs 80 grams (less tare), what is the specific gravity of the liquid?
21. How much will one U. S. pint of Nitric Acid U. S. P. weigh in grams?
22. What is a Physical Constant? Upon what physical constant is the Metric System primarily founded?
23. Convert 70°R to Centigrade and Fahrenheit. 87.5°C. 187.5°F.
24. Give the *equivalent* in Grains and U. S. Fluid Measure respectively of the following Metric quantities:

(*a*) Ammonium Chloride, 4.00 (*c*) Ether, 135 cc. 4 1/2 ℥

(*b*) Morphine Sulphate, 1.3 (*d*) Alcohol, 60 cc. 2 ″

IMPORTANT.

Students will please reply to the above questions on *letter-size* paper, *in ink*, writing only on *one* side of the paper, and forward promptly to the director, signed. In answering, it is *not* necessary to repeat the question itself but only the *number* of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

☞ In order to insure prompt attention all the rules of the "Important Notice," especially with reference to the use of letter paper and writing name and full address at the top of the sheet, must be complied with. Director.

National Institute of Pharmacy.

LECTURES, SEMI-MONTHLY, BY MAIL.
C. S. HALLBERG, Ph. G., *Director.*

DEPARTMENT OF EXAMINATIONS.

CHICAGO, July, 1891.

C. F. Carpenter, East Hampton, Conn.

Upon your answers to questions on Lecture....2....we make the following observations:

1. By conduction, convection, and radiation.

1. 2 1/2 ° F.; balance of heat retaining the latent for

2. a. Refer to lecture.

b. By enclosing in air-tight vessels.

Your rating on answers to Lecture 2 *is* 85 *per cent.*

The abbreviations "P.," "Col." and Par.," are used to indicate "page," "column," and "paragraph," respectively.

In rating the answers, your *general understanding of the subjects* and the *appearance of your paper*, are also taken into consideration.

☞ The above questions should be *carefully reviewed* upon receipt of corrections. If questions to any other Lectures remain unanswered, please send them in at once.

THE DIRECTOR.

Always continue to answer in the regular order without waiting for delayed observations. Corrections are always forwarded as promptly as possible.

☞ NOTICE.—Do not fail to write your name, full address and CLASS page 627, at the TOP of the first page of your answers.
In all correspondence the CLASS page must be stated in order to insure prompt attention.

Solution.

Solution is the mechanical separation and *diffusion* of the molecules of a *solid* substance through a *liquid*.

For example, when a small quantity of common salt is placed in water, it gradually disappears from view, the water becomes saline to the taste, and its specific gravity is increased. This liquid mixture of salt and water is called a *solution*. The liquid in which the solution takes place is called a *solvent*.

In all cases of solution proper, neither the solvent nor the dissolved solid undergoes chemical change. The solid retains all its original properties except solidity, and may, by evaporation of the solvent, be recovered from the liquid in the original form, without loss of weight. Such solutions are called, for convenience, *simple* solutions.

Solution is often accompanied by chemical combination; that is, the solid not only disappears in the liquid, but at the same time undergoes chemical change, or enters into combination with the liquid.

The resulting liquid is, for convenience, called a *chemical* solution, or a *complex* solution, but it must be borne in mind that the two processes of solution and chemical combination are radically different in their nature, and we must sharply distinguish them in thought.

Solution is purely a phenomenon of molecular attraction. The particles of the solid are pulled asunder and diffused through the liquid by virtue of the attraction exerted upon them by the molecules of the liquid. In chemical combination, on the other hand, a new force comes into play, that of chemical affinity, which changes the identity of the substances and builds up new compounds out of the old.

For example, if a small quantity of iodine be added to an aqueous solution of caustic potash, and the mixture be heated, the iodine will gradually disappear, but it will be found, on examination, that something more than solution has taken place. On evaporating the liquid, no iodine, as such, will be found, much, if not all, of the caustic potash will have disappeared, and iodide and iodate of potassium, entirely new substances, will be found in the residue.

Another difference between these important processes is their effect on temperature.

A *lowering* of the temperature always results from solution, while chemical combination invariably produces the *opposite* effect.

In the case of certain anhydrous salts, their solution in water produces an elevation of the temperature. This apparent exception to the law is due to the fact that the salt combines chemically with a portion of the water.

In the case of a mixture where both solution and chemical combination take place, it is evident that the opposite effects of these two processes on the temperature will tend to neutralize each other.

The solution of many salts causes so great a reduction of temperature, that advantage is taken of it to produce *freezing mixtures*, as when common salt is mixed with snow, a temperature more than forty degrees below the freezing point is attained.

Still another difference between solution and chemical combination is the fact that the latter takes place most easily between substances which are most unlike, while solution usually takes place most readily between substances that most resemble each other in composition and properties.

For example, mercury readily dissolves most of the other metals; ether dissolves the fats, and alcohol is a ready solvent of the resins.

As solution is one of the most important agencies in the hands of the pharmacist for performing many operations, such as the extraction of medicinal principles, the dispensing of various medicines, etc., it is important for him to understand the conditions most favorable to the process.

As a great general rule, whatever *weakens* cohesion promotes solution.

The means used to weaken cohesion are chiefly three in number:

(1) Heat.
(2) Mechanical division.
(3) Placing the substance to be dissolved in the most favorable position as regards the solvent.

Heat weakens cohesion, probably because it increases the spaces between the molecules, and also because it increases molecular motion.

At all events, a hot solvent is usually more speedy in its action, and takes up a larger quantity of the solid substance than a cold one. But the law has some notable exceptions. Common salt, for example, is no more soluble in hot than in cold water, and lime is far less soluble in the former than in the latter.

Mechanical division of a substance is accomplished in various ways: by agitation, by grinding, as in a drug-mill, and by trituration, as in a mortar. It not only weakens cohesion, but by reducing the substance to a fine powder exposes a vastly greater surface to the action of the solvent.

Where weak solutions of readily soluble substances are to be made, the method of agitation is usually to be preferred; that is, the substance is dropped into a suitable vessel, and the mixture shaken until solution is complete. Where strong solutions are required, or where the substance is not readily soluble, solution is facilitated by trituration with a solvent in a porcelain mortar. The substance is first rubbed to a powder, a little of the solvent is then added, and the rubbing continued until the liquid is saturated or nearly so, when this portion is poured off in the same way. This process is continued until all of the substance has been dissolved.

The importance of a favorable position of the substance with reference to the solvent, is shown in the method of *circulatory displacement*.

In this process the substance to be dissolved is suspended just beneath the surface of the liquid, on a porous diaphragm, or in a bag of some porous material. The liquid in contact with the substance dissolves a portion of it, has its specific gravity increased in consequence, and therefore sinks to the bottom of the vessel, and a fresh portion of the solvent is brought in contact with the substance. Currents are thus established in the liquid, the effect of which is to keep that portion of it, which is farthest from saturation, and has most solvent power, in contact with the substance to be dissolved.

Solution—(Continued).

SOLUBILITY.

In pharmacy, the *solubility* of a substance is the quantity of distilled water, at the temperature of 59° F. or 15° C., required for the solution of one part of the substance.

When, therefore, the solubility of a substance is spoken of, reference is had to its solubility in water, unless some other solvent is explicitly mentioned.

Different solids differ from each other very widely in solubility. A few are insoluble, many slightly soluble, and many freely soluble.

Some, like gum acacia, are soluble in all proportions, and some, like potassium chlorate and gypsum, only in limited proportions. Some that are insoluble or nearly so in pure water, become freely soluble in certain saline solutions, as for instance iodine, that dissolves but sparingly in pure water, is dissolved in large quantity by a solution of iodide of potassium in water. The reverse is usually the case, however, as for instance an aqueous solution of sugar will dissolve less of a salt than pure water.

Sustances that are sparingly soluble in one liquid may be freely soluble in another, as camphor, which is taken up only in small proportion by water, but is dissolved in very large quantity by alcohol; and sulphur, which resists the action of all ordinary solvents, but melts away like sugar in water, when agitated with bisulphide of carbon.

The quantity of any solid which any solvent will take up must be determined by experiment in each case, as there is no known law governing *solvent action*.

The solubility of most substances varies regularly with the temperature until a certain limit is reached, beyond which no further increase takes place; but in some cases solubility increases faster than the temperature, and in others it increases to a certain point with heat, and then declines.

A solvent is said to be *saturated* when it refuses to take up more of a given solid. The term is also used in a chemical sense. For instance, an acid is said to be saturated with an alkali when the solution is neutral to test-paper.

[For Table of Solubilities of the principal officinal chemicals, parts of water at 59° F. or 15° C., required for 1 part of the substance, see U. S. P., p. 426.]

A solvent is said to be *supersaturated* when it contains in solution more of a salt than it would take up if the salt were treated with the solvent at the given temperature.

For example, if we prepare a saturated solution of sulphate of soda in a test-tube, and stop the test-tube while the liquid is still boiling and allow the solution to cool, without agitation, to the temperature of the air, it may be kept for weeks or months without crystallizing; but if a glass rod be plunged into it, crystals will suddenly be formed through the entire mass.

The phenomenon is accounted for by supposing that the molecules, being held in equilibrium by their mutual attractions, are not free to obey the polar forces that produce crystallization until a disturbing cause is introduced.

The term supersaturated is also used in an entirely different sense by chemists. An acid, for instance, is said to be supersaturated by an alkali when more than enough of the latter has been added than is sufficient to neutralize the former.

Diffusion of one liquid through another is of the same nature as solution, and, like it, is a phenomenon of *molecular attraction*.

Liquids differ from each other very widely in their power to diffuse through water. Some, as the fixed oils, do not mingle with water at all; others, like the volatile oils, are sparingly dissolved by it, and still others, as syrups, glycerin and alcohol, mingle with it in any proportion.

OSMOSIS.

The mingling of liquids or gases by diffusion through animal or vegetable tissue capable of being wet by both liquids, is called *osmosis*. Such membranes possess multitudes of exceessively minute pores which constitute so many capillary tubes, by means of which the liquids are brought in contact with each other and enabled to commingle. This phenomenon is due to capillarity, a result of molecular attraction.

Dialysis is the process of osmosis applied to the separation of the crystallizable from uncrystallizable substances.

The strength of the currents passing in opposite directions through the membrane depends partly on the densities of the liquids and partly on their power to wet the membrane. Other things being equal, the strongest current is toward the denser liquid; and if the liquids are of equal density the stronger current will be toward the liquid that has the least power to wet the membrane.

Crystalloids diffuse readily through porous membranes, colloids do not; hence it becomes possible by osmosis to separate the latter from the former, by *dialysis*.

DIALYSER.

The Dialyser is represented in the figure, and consists of two vessels, one suspended in the other. The outer vessel contains the liquid in which it is desired to obtain the diffusible portions, distilled water being mostly used for this purpose. The inner vessel, or the dialyser proper, consists of a ring of India-rubber or glass, to which a piece of parchment paper is securely fastened, as in a drum, at the bottom. The liquid to be dialysed is poured into the last-mentioned vessel, which is then suspended in the water so that the bottom barely reaches below the surface of the water. In pharmacy this process is used in the preparation of dialyzed iron and some alkaloids.

Simple diffusion of liquids, when unaccompanied by chemical change, usually causes no change of temperature. But when equal volumes of alcohol and water are mixed, contraction takes place accompanied by a rise of temperature.

The *diffusion of gases* through liquids is called *absorption*.

This is also a phenomenon of molecular attraction, and does not differ in its essential nature from solution. Its effects on temperature, however, are often different from those of solution. In cases where large quantities of a gas are absorbed by the liquid, the temperature rises, because the absorbed gas is condensed in volume, and a portion of its latent heat is thereby rendered sensible. Also an elevation of temperature usually facilitates solution, while a lowering of the temperature increases the absorption of a gas. Pressure has the same effect. This is illustrated in charging a soda fountain with carbon dioxide.

Crystallization.

Many substances, under certain conditions, particularly when passing from a fluid to a solid state, arrange themselves in *regular geometric forms*. This process is termed *crystallization*.

Substances which crystallize are termed *crystalline*, while those that do not, as shellac, glue and glass, are called *amorphous*. Since substances in assuming the crystalline form tend to reject foreign matter, crystallization constitutes the best means at the pharmacist's disposal of obtaining many compounds in a state of purity.

Crystals may be formed in a variety of ways:

(1) *By sublimation*, or dry distillation. Such substances as iodine, camphor, sulphur, calomel, corrosive sublimate, chloride and carbonate of ammonium, may by this means be freed from foreign materials.

An apparatus for subliming camphor and obtaining it in a finely divided state, consists of a copper retort which connects with a receiving vessel, constructed of pasteboard or of tinned iron. The receiver is made rather large, so that the camphor vapor is well diluted with air; this causes it to be deposited in minute crystals.

(2) *By fusion.*—Many substances, as sulphur, the metals bismuth and antimony, and some salts, assume the crystalline form on cooling, from fusion. This method has few important applications in pharmacy. Of much greater importance is the next method.

(3) *By cooling* from solution, or by *evaporation* of the solvent. In the former case a saturated solution of the substance is made in an evaporating dish or other shallow vessel, at an elevated temperature, and the solution is allowed to stand until cold. After the crystals have been deposited, the mother liquid is drained off.

Usually not all of the substances crystallizes out at the first trial; the mother liquid should therefore be concentrated by heat, and again allowed to cool, and the process repeated so long as crystals continue to form.

In case large and well-formed crystals are desired, the solution should not be too strongly concentrated at first, and the crystals should be permitted to form slowly, and if the nature of the liquid will admit, by spontaneous evaporation of the solvent.

In case crystals are required in the form of fine granules, the solution should be concentrated until crystals begin to form around the edges of the dish, and then the solution should be cooled rapidly, and agitated during the cooling; or in many cases it is better to continue the application of heat until the solvent is evaporated, keeping up in the meantime the stirring. This process is called *granulation*.

Where the solvent is a highly volatile substance like ether, benzol or bisulphide of carbon, a cold saturated solution is made, and the solvent allowed to evaporate spontaneously. By dissolving sulphur in bisulphide of carbon, fine crystals of the former substance may be obtained by this method.

(4) *By chemical reaction* in the solution, by which an insoluble or less soluble substance is formed, which appears as a *crystalline precipitate*.

For example, if a filtered solution of ferrous sulphate, acidulated with sulphuric acid, be poured into alcohol, the ferrous salt is precipitated in the form of a fine crystalline powder, which is less liable to oxidizing changes than the ordinary sulphate.

PRECIPITATION.

Precipitation is the process whereby an *insoluble* compound is formed by mixing the solutions of two *soluble* compounds. The product is termed a *precipitate*.

In a chemical sense, precipitation is always the result of a chemical *decomposition*, new compounds being formed. Since the result depends upon the *insolubility* of the newly-formed compound, this process can only be employed where the product is known to be *insoluble*.

For example, when two soluble salts, potassium iodide and lead acetate, are dissolved separately, and their solutions mixed, a chemical change takes place, due to an interchange of the elementary constituents of the substances, and new compounds are formed, lead iodide, which being insoluble in water, is precipitated, and potassium acetate, which is soluble and remains in solution in the water.

The term precipitation is also applied to any substance which is thrown out of a solution from a liquid, as, for example, precipitates in tinctures.

The compound in solution is separated either by *filtration*, when heavy or crystalline, or by *decantation*, when flocculent or gelatinous.

Decantation is effected by pouring the liquid into a tall and narrow vessel. After subsidence of the insoluble portion, the clear liquor may be either "siphoned off" with a tube, or separated by pouring.

In pouring from such vessels, especially when not furnished with a lip, it is necessary to use a guiding rod to prevent the liquid from running down the outside, as shown in the illustration.

Washing of the precipitate is done either as described under filtration, or by decantation.

Elutriation.—This process is based upon the principle that some substances, when *finely divided*, are, owing to adhesion, temporarily suspended in water, and may thus be separated from coarser particles or impurities.

For example, when crude calcium carbonate, or chalk, is ground in a mortar, and a large quantity of water added, the fine particles will be suspended in the water. When this is poured into a tall vessel, the finely divided solid will soon subside, and permit the decantation of the clear liquid. The product after being pressed and dried constitutes "prepared" chalk.

Filtration.

Filtration is the process of removing *undissolved* matter from a liquid; the clear liquid thus obtained is termed the *filtrate.*

When applied to viscid substances, such as syrups, oils, etc., to remove grosser impurities, it is termed straining.

Filtration, in pharmacy, is usually applied to solutions in which the substance dissolved has been thrown out of solution—precipitated, from change in temperature or other causes. It is always effected mechanically by passing the liquid containing the undissolved matter through some material of sufficiently close texture to arrest the solid particles, while the clear liquid is allowed to flow through freely. Such material is termed a *Filtering Medium* (plural, *media*).

The nature of the filtering medium used, depends upon the *mobility* of the liquid and the character of the undissolved matter. With watery, alcoholic, ethereal and similarly mobile liquids, when not too concentrated, filter paper is commonly used.

Filter paper is of two kinds, gray and white, in circular and square sheets respectively.

Gray filter paper is the kind employed in pharmacy; it is made of woolen rags, and is therefore coarser and more porous than the white, or so-called Swedish filter paper, used in analytical operations. The gray filter paper is stronger, can bear the weight of a larger quantity of liquid, filters more rapidly, and is therefore to be preferred when large quantities of galenical preparations, *i. e.*, tinctures, medicated waters, etc, are to be filtered.

The *rapidity* of filtration is of great importance, both for expediting work and to prevent loss by the evaporation which occurs, unless the vessel used in the process be well covered, a precaution not always wholly practicable.

Filtration is favored, other things being equal, by the following considerations:

(1) The filter should be carefully folded.

The *apparent* facility with which a liquid may be filtered and the convenience of using a filter quickly and carelessly folded, should not be taken into consideration, because the labor spent in folding the filter *properly* will be repaid *ten-fold* in the saving of time, and by diminishing the evaporation, proportionately increasing the quantity of filtrate obtained.

The *folding* of a filter, or "plaiting," is accomplished in various ways, but no filter can be considered perfect unless folded to resemble a fan with 32 exactly equal parts, with the edges perfectly even when laid together (as in a fan) and narrowing down to as small a point as possible, without breaking the paper. The result is easily accomplished in a very simple manner, as follows:

A sheet of round filter paper is first straightened; the crease in the sheets as they lay in packages is usually more or less at one side; this is first remedied by opening out the sheet, and then folding it so as to bring the semicircular edges exactly together, with the thumb nail or a horn spatula the diameter edge is now sharply made, the next fold is made by doubling the half sheet into quarters; one quarter is then opened out and folded forward into eighths; the upper eighth is opened and doubled forward up to the crease already made for the first eighth; this gives us one-sixteenth, which is folded back one-half, making the one-thirty-second; each crease must be made perfectly straight, sharp, and almost even to the point.

For a better illustration we shall now number the $\frac{1}{32}$ parts in the quarter (already completed) consecutively from 1 to 8. In folding the remaining creases, they are made, as before, without *raising* the paper from the table, no twisting or turning being necessary. The folding is now done alternately forward and backward, the first 4 parts being folded forward in crease 4, and parts 1, 2 and 3 folded back; the 4 parts thus creased are folded over the remaining 4 parts or *up to the quarter fold*, then back so as to crease 5 and 6, over again *through* the quarter fold and then turned back so as to crease the parts 7 and 8. The two quarters, or one-half the filter, is now finished, and the remainder is folded in precisely the same manner, making the filter complete.

(2) The filter should be pushed down into the neck of the funnel as far as it can be without rupturing the paper.

This is especially desirable when syrupy liquids are to be filtered, such as elixirs and similar liquids which filter slowly. For this purpose a funnel with a wide neck should be employed (see Funnels); the point of the filter paper is by this means strengthened, and the crevices formed in the paper, when pushed down into the comparatively narrow neck of the funnel, facilitates filtration, and aids in rendering the filtrate clear.

This fact is taken advantage of in the arts in the filtration of syrups, oils, etc., through bags made of filtering cloth in the following manner: A long bag, narrow at the top and gradually widening at the bottom, is forced into a narrow tin cylinder so that the sides of the bag are filled with fissures and furrows; the upper end of the bag is securely fastened to an opening in the lid of the tin cylinder, which is screwed on air-tight. The liquid to be filtered is permitted to flow through this opening into the bag; the insoluble matter which it holds in suspension lodges upon the protruding sides of the confined bag *gradually*, not in such quantity as to prevent the outflow of the clear liquid, which would be the case if a bag with straight sides were employed.

Filtration is usually further facilitated, in this and other kinds of filters, by allowing the liquid to flow through a tube, which is connected air-tight with the filter, from a height of 10 to 30 feet; this is termed filtration by *pressure.*

(3) The filter should be thoroughly moistened before filtration is commenced.

In filtering liquids which readily mix with water, this is very important. The fiber of filter paper, owing to its porosity when dry, absorbs considerable water (capillary attraction); in filtering watery solutions, therefore, the solid which was held in solution, is left more or less undissolved in the pores by the attraction of the water, thus preventing the penetration of the liquid. With saturated solutions this is so marked that some of these may be poured upon a paper filter not previously moistened without any of the liquid passing through; such examples we have in syrups.

The filter, accurately plaited, is opened out completely and then pushed into the neck of the funnel, as before described; by gently pressing the top with the flat hand, while held there firmly to prevent its slipping up, a small stream of water is sent into the funnel by means of a wash-bottle or "spritz." When the paper has become in the least moist, it will adhere to the glass without danger of slipping, and the hand must be removed, since the least pressure will rupture the paper. The funnel is now gently turned by the hand so that the thin stream of water may be evenly distributed, then set aside for a few minutes to allow the superfluous water to drain off, when it is ready for use.

Filtration—(Continued).

In filtering, the following points should be observed: (1) provision must be made for the air to escape from the receiving bottle; (2) the filter should be replenished with the liquid so as to be *completely* filled as long as the quantity permits; and (3) the funnel should be kept *covered*.

The air is usually allowed to escape by placing a loop of twine in the neck of the receiving bottle. Funnels, ribbed on the outside, are also used with this object in view, but these do not answer the purpose as well as the twine, for the reason that glass, when pressed into the neck of a bottle, becomes frequently wedged in so tightly as to break when its removal is attempted.

The more liquid in the filter, *the greater the pressure*, and therefore more *rapid* the filtration; hardening of the undissolved matter, and consequent stopping up of the pores of the paper, may be prevented by having the filter as *full* of the liquid as possible.

The funnel should always be kept well *covered*, to prevent evaporation; this is best effected by the use of pieces of rubber packing, which fit closely on the edge of the funnel; pieces of glass or cardboard may also be used.

The filter-paper must never extend *above* the top of the funnel.

The plaited filter, previous to being moistened, should be inserted in the funnel and measured as to length; if it extend beyond the "rim," it should be cut off evenly, so as to reach rather half an inch below than above the top. This is done partly to facilitate covering the funnel, which can not otherwise be effectually done, but more especially to prevent *evaporation*, which sometimes takes place so rapidly, when the filter extends considerably beyond the funnel, as to carry some of the liquid down the outside. An illustration of this phenomenon, due to *capillarity*, is shown in the accompanying figure.

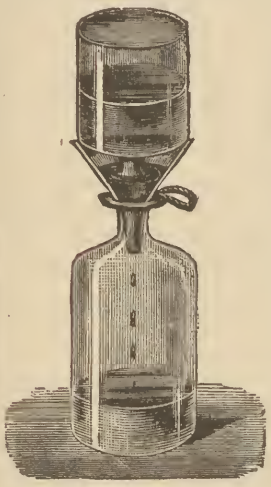
White filter-paper is rarely used in pharmacy; it is well adapted for the analytical laboratory and for filtering acid and alkaline solutions where the gray would be objectionable, because of its colors and impurities soluble in chemical reagents.

Its principal use in pharmacy is in filtering solutions containing precipitates, which latter it is desired to obtain pure by washing with water. For this purpose a funnel resembling an equilateral triangle is most convenient, since the precipitate is more exposed upon the sides than in the ordinary funnel for pharmacal use. This filter-paper is also folded in quarters, and simply dropped into the funnel to adjust itself by the weight of the contents, so that all portions of the precipitate may be washed by the water poured upon it. This filter-paper may be "toughened" so that it will bear the weight of acids and alkalies by immersing it in strong nitric acid (sp. gr. 1.40), and then washing with water. Paper treated similarly with sulphuric acid becomes also very strong, but is not easily permeated by liquids. This is the substance known as *parchment*.

Various devices are in use for facilitating filtration, such as *filter-racks*, made of wire; also *supports*, consisting of a china cone with openings in the sides, to be placed inside the funnel, etc. These do not insure such rapid filtration as by the simple funnel and attention to the above rules.

Continuous filtration is employed when larger quantities are to be filtered, and when the filter is of limited capacity.

It may be effected by inverting the bottle containing the liquid over the funnel through an opening in the cover, which admits the neck below the top of the filter, as shown in the illustration. By this arrangement the filter is kept filled with liquid up to the level of the neck of the inverted bottle as long as any liquid remains in the receiver, the liquid acting as a valve, by excluding the air from the latter. As soon as the liquid in the filter sinks below the neck of the container, air rushes in and displaces it until the level is again reached, thus working automatically. The splashing by the out-rushing air may in a great measure be prevented by inserting a perforated cork in the neck of the container, so that the displacement will take place more gradually.



Filtration by vacuum is accomplished by exhausting the air from the receiving vessel with an air pump. It is only employed in the chemical laboratory in filtering viscid alkaline solutions, or such liquids as act upon the filter-paper, causing it to retard their flow. A small perforated cap of platinum is placed in the neck of the funnel to prevent the point of the filter from breaking by the suction created. The *mercury pump* is the means employed in small operations for producing a vacuum; in the arts, pumps worked by steam power are used.

Filtration of oils is effected either in the cold, or through heated filters.

In the cold, oils require to be filtered through substances more porous than paper, *i. e.*, cotton, flannel, etc. Few oils (fixed) can be filtered when cold, especially the vegetable oils, cottonseed, castor oil, etc., since they contain a large percentage of gum. By gently heating them, however, by the water-bath filter, they may be filtered without difficulty; but care must be taken that the filtration does not take place at too high a temperature, lest they become cloudy again upon cooling.

Hot or water-bath filters are constructed in different ways, the most common form being an ordinary funnel placed in a double or jacketed cone of tinned iron filled with water, and furnished with a projecting tube which is heated in a spirit-lamp.

For larger operations, a tin-box water-bath, in which a conical space admits the funnel so that its tube extends below the bottom, is the kind usually employed. It is conveniently heated by a gas jet.

Filtering media, other than those mentioned, are:

Absorbent Cotton, for neutral mobile liquids.

Sand is sometimes a very useful filtering medium, but is only adapted in connection with alternate layers of charcoal, for filtering large quantities of water. It is also frequently mixed with gummy or resinous substances to facilitate the passage of liquid solvents.

Sponge is used for straining, but does not present any advantages, since it is difficult to clean perfectly, and too costly to reject when only once used.

Chamois skin is sometimes used as a filter-cloth, when pressure is applied. Owing to its great strength it is not liable to rupture.

Filtration—(Continued).

Straining.

Straining differs from filtration mainly in that more porous substances are used for filtering the liquids than filter-paper.

This process is usually applied to more viscid liquids or mixtures to free them from gross impurities, as, for example, in the making of syrups.

The materials most frequently used for straining are: Canton flannel, felt bags, cotton, unbleached muslin, and calico.

For *small* quantities, flannel, or a plug of absorbent cotton, placed tightly in the neck of a funnel, are the most convenient.

For *large* operations, as in making syrups by the gallon, a felt bag is the most convenient and satisfactory means, since the whole amount of liquid may be poured in at once and returned to the bag until it runs clear.

The *tenacle*, consisting of four pieces of wood joined together so as to form a square, and furnished in each corner with a projection upon which the filter is fastened, is a convenient device for suspending the bag or filter cloths above the receiving vessel. It may be supported by a stand, or suspended from the ceiling by a hook.

In straining syrups, it is even more important that the strainer be thoroughly moistened with *water* than in filtration through paper.

When a felt bag is used, it should be soaked in water until completely saturated, then wrung out or pressed as hard as possible to free it from superfluous water. When the liquid to be strained is poured in, it displaces the water, which first comes through almost pure, and should be returned to the filter. Since a considerable portion of the liquid remains in the pores of the filter at the close of the process, it should be also displaced by the addition of sufficient water to make up the measure, but the product should then be carefully mixed so as to be uniform in strength.

Clarification.

When a liquid contains insoluble matter suspended in so finely divided a form that it cannot be separated by simple filtration, some other *insoluble* substance is added to which the insoluble matter is attracted; the liquid may then be obtained clear—*clarified*.

When clarification is effected by filtration, the insoluble substances used form a layer over the filter, which retards the insoluble matter, but does not impede the flow of the liquid.

The substances used for this purpose in order of their merits are:

(1) *Paper pulp*, prepared by beating in a bright iron mortar a sheet of gray filter-paper, moistened with sufficient water to make a pasty mass.

After pressing out the water, the pulp is added to the liquid and thoroughly mixed by agitation. In commencing filtration, the first portions of the filtrate must be returned to the filter until the pulp has formed a layer over the sides, after which the product is obtained clear. Paper pulp is especially useful in filtering elixirs and straining syrups.

The following are mostly useful in filtering medicated waters and elixirs:

(2) *Insoluble* chemical substances, such as Calcium phosphate, and Talcum; also Magnesium carbonate.

Since substances used for clarification must be insoluble in the liquid, that they may not contaminate the filtrate, magnesium carbonate is objectionable owing to its slight solubility in water, especially if the latter be acid. For this reason magnesium carbonate has been superseded in the U. S. P. by calcium phosphate, which is nearly insoluble in neutral liquids.

(3) *Albumen*, in the form of egg-white or milk, is used when clarification is effected by chemical means, by combining with the soluble matter and forming insoluble compounds, which are usually thrown down to the bottom of the liquid—*precipitated*, and, also, on *coagulation* by heat, it *envelops* the solid particles, and, removing them from suspension, leaves the liquid clear.

In domestic practice "coffee" is clarified by addition of egg-white; in the arts, beer by gelatin or isinglass, similarly used. *Gelatin* forms a very insoluble compound with tannic acid, as, for example, in the preparation of leather; and as the insoluble substances which we desire to reject by clarification are mostly tannic acid derivatives, its value for this purpose is clearly recognized.

Decoloration.

When it is desired to free a liquid from color, it is easily effected by filtration through some absorbent substance, such as charcoal.

Animal charcoal, in powder or granulated, is the best; it should be placed upon some porous filtering substance. Alternate layers of sand and charcoal are very effective, not only for decolorizing liquids, but also to free them from organic impurities, which the charcoal absorbs.

Funnels used in filtration should be of *glass*, in order that the process may be watched; also because they are easily cleaned, and not acted upon by chemicals.

The *shape* of a funnel for filtering purposes should be that of a V rather than so wide at the top as the glass funnels generally found in the shops; instead of having an angle of 65 degrees, one of 50 degrees will filter much more rapidly.

This is explained by the fact that the column of the liquid is thereby heightened, and more pressure is obtained, since the latter increases in proportion to the height of the liquid.

On the other hand, the tube portion of the funnel should be as wide as possible, gradually sloping for a distance of several inches, or in proportion to the size of the funnel, about one-third the length of the tube. The end of the tube, or, as it is sometimes called, the "neck" of the funnel, should not be too thick, as is frequently the case, since it then prevents inserting the funnel in the necks of bottles, but of a thickness uniform with that of the glass in the other part of the funnel.

The *washing bottle*, or "spritz," is a very useful adjunct in pharmaceutical work for washing precipitates, wetting filters, and for introducing small quantities of water in test-tubes, etc. It consists, as shown in the illustration, of a rather wide mouthed bottle furnished with a deeply-perforated cork, into which two bent glass tubes are introduced, one reaching down into the liquid, and a shorter one ending just above the surface. By blowing in the short tube the air, pressing upon the surface of the liquid, causes it to rise in the long tube, and to flow out at the end

Extraction.

Extraction is any process by which the soluble matter of vegetable drugs is obtained, or separated from the insoluble portion. When completely effected, we may say that the drug is *exhausted.*

Extraction may be effected by :

(1) Maceration and expression.
(2) Percolation or filtration.
(3) Or these processes combined.

Maceration consists in mixing the drug, reduced to a coarse powder, with the liquid used for extracting (menstruum), and allowing the mixture to stand for some time (from 1 to 36 hours), according to the proportion of the menstrum used, and the nature of the drug.

When the soluble matter of the drug has become dissolved in the menstruum, it is obtained as a clear liquid free from the insoluble portion, the marc, by *expression.*

Expression is the process of straining through a suitable cloth with pressure, exerted either by hand or by a *screw-press.*

The most effective way of expressing by hand is to fold together the edges of the press-cloth so that one overlaps the other (as in wrapping a paper package), the ends being meanwhile gathered up so as to prevent the mixture from running out. These ends are then twisted in opposite directions, care being taken that the middle fold does not give way.

The custom of adding a portion of menstruum to the marc (drug) after expressing it, is not to be recommended, unless necessary to make up the measure of the product. It is preferable to use as much more menstruum originally as will be retained by the marc, which can easily be approximated by experience and observation.

In extracting a drug by simple maceration the temperature should be moderately *warm*, as the solvent action on the drug is then *greater.*

In extraction by any form of maceration, with or without heat, the drug must be in a *coarse* powder.

When in fine powder the small particles of drug rapidly swell and adhere to each other as soon as they come in contact with the liquid, and thus prevent the menstruum from exercising its solvent action. When crystalline substances, *i. e.*, chemicals, just the opposite is true as noted under solution. The expression of the liquid is also more difficult when fine powder has been used, since the fine portions clog the pores of the press-cloth.

When a drug is macerated in hot water for a short time, by pouring boiling water upon it in a well-covered vessel, the liquid obtained by expression, upon the cooling of the mixture, is termed an *Infusion.*

Drugs containing volatile principles, *i. e.*, chamomile, valerian, etc., are frequently prescribed in this form. The boiling water extracts these principles, and if a proper vessel be used, such as the "infusion mug," which can be tightly covered, the water will gradually condense, retaining the fugitive constituents. Infusion from drugs whose active principles are volatilized by heat, are prepared by simple maceration in the *cold, i. e.*, infusum pruni virginianæ.

Digestion.—When a moderate heat is applied to facilitate solution in connection with maceration, the process is termed digestion.

When the mixture is boiled for some time, the liquid product obtained by expression is termed a *Decoction.*

PERCOLATION.

As *extraction* is the most common of the arts in pharmacy, so *percolation* is the most important related process, since it is the most *effective, economical* and *expeditious* method for the extraction of medical principles of drugs.

Percolation is the process of extraction by which the soluble matter of a drug is obtained by exposing the drug to the solvent action of a liquid in a vessel termed a *percolator.* The product is termed the *percolate.*

This process is also called *displacement,* because it is based upon the principle that the solvent, after being charged with the soluble constituents of the drug is *displaced* by fresh portions of the solvent liquid, and partly from its own weight, partly from the pressure of the supernatant liquid ; this action, if not mechanically interrupted, and if the supply of solvent be constant, will continue until the liquid reaches the outlet at the bottom of the percolator.

By continuing the supply of solvent, which is termed menstruum (plural, menstrua) when used in extraction, the displacement of the liquid in which the soluble matter is in solution may be effected until no more is to be dissolved from the drug, when this is said to be *exhausted.*

The *exhaustion* of a drug is generally determined by the *color* and *taste* of the percolate.

With resinous drugs it may be conveniently determined by mixing a few drops of the percolate with water ; if exhausted, the percolate will not turn the water milky. In percolating drugs containing alkaloids, complete exhaustion has been effected when the percolate does not show any precipitation with reagents for alkaloids.

This is called *simple* percolation, and is the process usually followed in the preparation of tinctures, wherein the quantity of menstruum is largely in excess of the drug to be extracted.

When employed, however, for more concentrated preparations, viz., *fluid extracts,* where the volume of the product must correspond with the quantity of drug used in the extraction *measure for weight,* it is necessary to concentrate the percolate. The first three-fourths portion of percolate contains nearly a corresponding proportion of the principles of the drug, while the remaining one-fourth of the soluble matter requires usually a much greater amount of menstruum before it can be displaced. The first or three-fourths portion of the percolate is therefore *reserved,* and extraction continued until the exhaustion is complete ; the percolate thus obtained, being very dilute or *weak,* is concentrated to the required bulk, with the application of the least possible amount of heat, and then mixed with the reserved percolate. (See Preliminary Notices—Percolation U. S. P., 1880, page xxxv).

Fractional or *re-percolation,* introduced by Dr. E. R. Squibb, is a process by which the drug may be exhausted *volume* for *weight,* without entailing evaporation.

It differs from simple percolation in that the drug is divided into four portions, and packed in as many different percolators ; each portion is treated as in simple percolation, except that the weak percolate obtained from each is used to moisten and extract each *succeeding* portion, the first percolate being reserved and mixed finally with the percolate from the last percolator, when their *combined volume* corresponds to the weight of the drug.

Simultaneous fractional percolation is a modification of the process of re-percolation, recommended by C. S. Hallberg (see The Western Druggist, Vol. X, No. 1).

Percolation.

To conduct percolation successfully, the following points must be observed

(1) Appropriate apparatus.
(2) The fineness of the drug.
(3) Careful packing.
(4) The use of proper menstrua.

The *Apparatus* employed in percolation is simply a vessel containing the drug, a receiving bottle, and sometimes a tube to carry the percolate into the receiver without loss by evaporation, and to regulate the flow.

Formerly glass *funnels* were much used for percolation. While these answer fairly well for extracting, when the product is not desired too concentrated, such as tinctures, they have been superseded quite generally of late by percolators.

A *Percolator* is a funnel with more or less cylindrical rather than conical sides, which are deeper proportionally than those of a funnel. The outlet tube, or "neck," is shorter and made thicker than in a funnel. They are made of glass, tinned iron, earthenware and wood.

Glass percolators are to be preferred, because in packing the drug the operator is enabled to see the material from the outside, and thus obtain better results; also because the percolation can be observed in its various stages, and proper means taken to render it more effective if necessary. The rate of extraction and exhaustion, when completed, may easily be recognized, also when the menstrua has sunk below the surface of the drug, the necessity of replenishing will be at once noticed.

Tin percolators, though largely used, are in most instances objectionable, not only because they are lacking in the advantages of glass, which alone should be sufficient to condemn their use, but also in that the material from which they are made is usually acted upon by drugs. This material, consisting usually of sheet iron very poorly tinned, soon becomes corroded by the action of the acids nearly always present in vegetable drugs; it is also liable to rust from contact with the water in the menstruum. When drugs containing larger proportions of acids, especially of tannic acids, *i. e.*, cinchona, rhubarb, etc., are percolated in tin percolators, the reaction is so great as to contaminate the percolate, which may be detected by a darker coloration (due to the presence of tannate of iron) than in products where glass vessels have been employed. With this class of drugs, therefore, tin percolators should never be used. With drugs not containing tannin, viz., oleoresinous drugs,—buchu, cubeb, etc.,,—tin percolators are not objectionable on this account, but nevertheless objectionable for the reason that the soldering seam is seldom air-tight, resulting in evaporation and loss, both of alcohol and percolate. Tin percolators, as found in the market, should only be used in crude operations, since they are rarely correctly constructed as to shape or dimensions.

Wood and *earthenware* percolators are not adapted for use in a pharmacy, as they are too heavy and large. They are largely used in manufacturing, where glass would be too fragile or too expensive for percolating drugs which would affect metal, or when chemical solvents are used, such as dilute acids

The *dimensions* of percolators, constructed either of glass or metal, as generally found in the market, are not such as to give the best results in percolation.

The theory now regarded as the true one is, that the *higher* the column of the drug in proportion to its *width*, the more effective the process of extraction. This requires that the percolators be *tall* and *narrow*.

If a given quantity of a drug in a percolator occupies a height of 8 inches and a nearly uniform width of 1½ inches, it is evident that a greater portion of the drug will be exposed to the same quantity of menstruum than if of a height of only 4 inches and a corresponding width of 3 inches. The amount of liquid is so confined in the former that it must percolate through *twice* the quantity of the drug as compared with the latter, and consequently be *twice as effective* in extracting the drug.

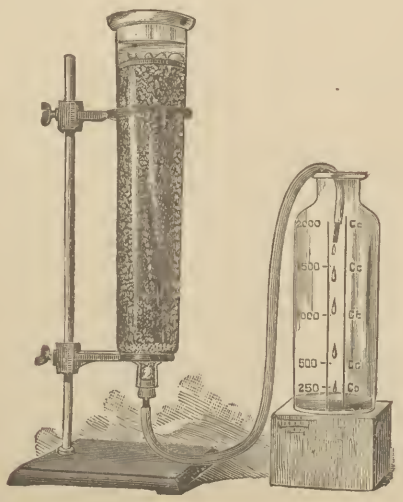
By this means it would be possible, if we could extend the height of the column indefinitely, to exhaust the largest quantity of the drug with the very smallest amount of menstruum, were it not that after the liquid becomes so thoroughly charged with the soluble matter—*saturated*—that it stops in its descent, and percolation is interrupted.

It is therefore necessary, in choosing a percolator for operating upon a drug, to determine how *far* the application of this principle may be practically carried without stopping the descent of the liquid. Upon this theory percolators are now constructed.

The *neck* in this form of percolator should be short, with the orifice tapering outward, so as to permit the insertion of a cork from the outside, which cannot be done in the old style. Into the cork, which is perforated, a piece of glass tubing is inserted, upon which a *rubber tube* is fastened, of convenient length for carrying the percolate into the *receiving* bottle. For the latter, any bottle will answer, but a graduated wide-mouthed bottle is the best. In the absence of a graduated "etched" bottle, one may easily be improvised by placing a narrow strip of cloth adhesive plaster lengthwise upon the bottle, measuring into it water by the ounce or more, and then marking the strip carefully at the level of the water. A strip of paper pasted on the bottle may also be used, but it then requires a coat of varnish.

The *rate of flow* of the percolate may be nicely regulated by *raising* or *lowering* the end of the tube, which dips into the receiver, and may be entirely *stopped* by raising it to the *level* of the menstruum in the percolator.

The accompanying illustration shows a modern percolator in use. From the ease with which the flow can be



regulated or entirely suspended, this form of percolator has been officially indorsed in the U. S. P. '80.

Percolation.—(Concluded.)

The proper *fineness* of drugs for percolation is very essential to the success of the process. If the drug is in too *coarse* a powder, exhaustion will not be complete ; if too *fine*, percolation will cease.

With most drugs, the degree of fineness of the powder suitable for percolation is directed by number (see Sifting, Lecture II) in the U. S. P.

In drugs not officially recognized, the number of powder used should be the same as that of an official drug containing similiar constituents. [For the general law and principles governing the degree of fineness of drugs for extraction, see "Comminution," page 17, Lecture II.]

Packing.—A drug should always be *moistened* before packing it in the percolator.

The powdered drug, contained in a shallow dish, is uniformly sprinkled and then thoroughly mixed with sufficient menstruum to cause it to adhere in a mass when pressed in the hand, but not so wet that it will not readily break up and fall into a powder.

In *moistening* drugs containing a large proportion of soluble matter, extractive or gum, sugar, etc , the powder agglutinates, especially if very fine, as in cinchona and rhubarb, forming small balls which cannot be rubbed to powder with the hands

Such moistened powder should be sifted through a coarse sieve, and the agglutinated particles rubbed through with the flat hand.

As a rule, the *more extractive* a drug contains, and the more *aqueous* the menstruum, the more difficult it is to moisten.

Conversely, the *less extractive* in the drug, and the more *alcoholic* the menstruum, the easier it is to moisten, and therefore the less care is required.

This is also true of *packing* the powder in the percolator. With the first mentioned class, great care must be taken that the powder be dropped successively in small quantities, and that the pressure in packing be not so great as to cause formation of compact layers of the drug, which could only be penetrated by the menstrua with great difficulty, if at all. On the other hand, with the latter class, containing less extractive and requiring alcoholic menstrua, such as buchu, cubeb, ipecac, etc., the packing may be done much more quickly and with less care, since these powders are easily penetrated by the alcoholic menstrua.

In packing any drug, however, the following procedure should be observed :

First, prepare the percolator by inserting a piece of absorbent cotton (cut across the fiber to expose the pores) in the neck, and of such size that it covers the bottom of the percolator. Upon this a piece of filter paper, cut round and "nicked," is carefully laid so as to extend a half-inch up the sides, being first moistened with the menstruum. The first portion of powder is then introduced, and should be done carefully to guard against any falling between the filtering media ; it is then distributed evenly, and gently pressed. With the second portion the pressure is somewhat increased and continued with each successive portion until all the powder is packed.

For packing, a cylindrical piece of wood, cut square at the end, is used. The powder is now covered with a disk of paper or cloth, upon which is placed a few pieces of glass or similar heavy material to keep it in place. The menstruum is then poured in, a sufficient quantity constantly being supplied to keep the surface of the powder covered until the percolate begins to flow at the end of the tube, when the percolator should be carefully covered and set aside, if maceration is directed or deemed necessary.

Maceration.—It is not necessary to continue maceration more than 24 hours with drugs containing little extractive, but with more extractive drugs, also such as contain alkaloids, dissolved with difficulty, *i. e.*, cinchona, hyoscyamus, nux vomica, etc., the maceration may be prolonged for three or four days.

With this latter class it is always best to allow the powder to macerate for an hour or two *before* it is packed in the percolator, so as to permit it to "swell"; without this precaution, the drug is liable to swell when confined in the percolator, and thereby impede the flow of the menstruum.

The *menstruum* (plural, *menstrua*) or the liquid used for extraction, is usually alcohol, or alcohol diluted with water in various proportions, sometimes with an addition of glycerin. When the greater proportion is water, the menstruum is generally said to be *aqueous ;* when alcohol is the greater, it is termed an *alcoholic* menstruum.

Chemical solvents are sometimes employed for the more effective extraction of drugs whose principles are soluble with difficulty in *neutral* menstrua.

Alkaline menstrua are employed with resinous or acid drugs, such as glycyrrhiza and rhubarb, and *acid* menstrua, when the active principles consist of *alkaloids*, as in cinchona, conium and nux vomica.

The menstruum should be selected with reference to the following considerations :

(1) Its solvent power.

(2) Its adaptability for holding the extracted matter permanently in solution—to prevent precipitation.

The *character* and *solubility* of the constituents of the drug must be known to insure the use of the best solvent.

As a general rule, therefore, alkaloidal, resinous and oleo-resinous drugs, require *alcoholic* menstrua.

Acid and extractive drugs require *aqueous* menstrua. There are, however, some exceptions to this rule, and the menstrna directed in the U. S. P. should be used in all officinal preparations.

In some drugs the constituents vary greatly as regards solubility, since they contain at once oils, acids and alkaloids, all possessing medicinal value.

In such cases it is difficult to select such menstrua as will extract all these constituents without their subsequent precipitation in the percolate.

Glycerin is here well adapted as a medium, since it possesses *intermediate* solvent properties between alcohol and water, as it dissolves *all* the principles soluble in either alone, to a great extent.

The *use of glycerin* and its value in menstrua, were, however, until recently, exaggerated. Its use should be confined to menstrua having only the above purpose in view.

The *displacement* of the menstrua with weak alcohol or water should not be attempted until the greater portion of the extract has been obtained. It is best to begin with a liquid slightly less alcoholic in strength, and then gradually increase the proportion of water until finished. With drugs containing considerable gum, starch, etc., liable to swell, greater care must be taken, that water be not used too early in the process.

Questions on Lecture II.

1. Name the three *states* of Matter.

2. Define the difference between Latent and Sensible Heat.

3. In what way may *heat* be propagated?

4. Upon what *medium* is Heat and Light propagated?

5. What two forces act upon Matter in a molecular condition?

6. Name the three kinds of Ether waves.

7. If one pound of Steam be condensed into three pounds of Water at the temperature of 70° F., what will be the *temperature* of the *entire measure* of water?

8. Why does the *solution* of a salt cause a decrease of temperature?

9. What is the difference between Desiccation and Exsiccation?

10. Define the term Garbling.

11. What standards are adopted by the U. S. P. for the various degrees of fineness of powders.

12. What are most favorable *conditions* for a drug to undergo decomposition.

13. What causes the condition known as Ebullition, or Boiling?

14. What is meant by Evaporation?

15. Under what conditions does evaporation best proceed?

16. What is an impalpable powder?

17. Define the difference between Sublimation and Destillation.

18. Why are Water, Sand and Oil respectively, employed as *baths* in the process of evaporation?

19. Why should a Drug be in *coarse* powder when an *aqueous* Menstrum is used?

20. Mention one product resulting from each of the following processes: Carbonization, Calcination, Sublimation and Distillation.

21. Define Fusion, and mention several *preparations* in which the process of fusion is employed.

22. What is the difference between Deliquescence and Efflorence? How may they be avoided?

IMPORTANT.

Students will please reply to the above questions on *letter-size* paper, *in ink*, writing only on *one* side of the paper, and forward promptly to the director, signed. In answering, it is *not* necessary to repeat the question itself, but only the *number* of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

☞ In order to insure prompt attention all the rules of the "Important Notice" must be complied with.

Director.

National Institute of Pharmacy.

LECTURES, SEMI-MONTHLY, BY MAIL.
C. S. HALLBERG, Ph. G., *Director.*

DEPARTMENT OF EXAMINATIONS.

CHICAGO, Aug. 1891.

C. T. Carpenter, East Hampton, Conn.

Upon Questions on Lecture III., Series 7, we transmit the following printed answers for further comparison and study:

1. Both terms imply reduction to the liquid form; the former by the intervention of a substance possessing solvent powers, with or without the aid of heat; the latter by direct application of heat.

2. Chemical Affinity or Chemism.

3. Solution, which entails transformation of Sensible Heat to the Latent form.

4. Comminution, application of heat, favorable position with regard to the solvent, agitation, etc.

5. A Solution is said to be saturated at a certain temperature when the solvent has taken up all of the substance it can at that temperature. It is supersaturated when more of the substance than can be ordinarily retained at that temperature is present, owing to special physical conditions.

6. The Solution of a substance usually has a greater density and higher boiling point than the original Solvent.

7. (*a*) Liquores. (*b*) Water, except for preparing Liquor Guttæ Perchæ.

8. (*a*) No. (*b*) Calcium Hydrate, Carbolic Acid, Cream of Tartar, etc., are quickly though sparingly soluble in Water.

9. Molecular attraction and motion.

10. Osmosis is the exchange of liquid through a diaphragm or porous membrane. Dialysis is the osmotic separation of crystallizable from uncrystallizable substances.

11. Precipitation is the separation of solid matter from a clear solution.

12. Refer to page 25.

13. (*a*) Refer to page 25. (*b*) Rubbing an insoluble substance to fine powder in presence of water.

14. The separation of solids from liquids by means of porous material

15. When a liquid containing suspended solid matter is allowed to remain at rest, the latter falls or precipitates to the bottom of the vessel. This act of the solid is spoken of as its Subsidence, while Decantation refers to the pouring off of the clear, supernatant liquid.

16. Paper, Cloth, Sand, Asbestos, Charcoal, etc.

17. By filtration through charcoal.

18. The Albumen of the egg-white unites with the Tannin of coffee to form an insoluble coagulum which mechanically envelopes suspended particles.

19. Filtration is commonly confined to the passage of liquids through paper to free them of undissolved matter; a cloth is employed in straining instead of paper.

X 20. Gravitation and Capillarity.

21. The absence of Taste, Color, Odor, etc., in the percolate other than that which belongs to the menstruum itself.

22. Refer to page 30.

X 23. To facilitate complete extraction.

X 24. Coarse powders are used for aqueous menstrua, fine for alcoholic ones.

25. (*a*) Refer to page 31. (*b*) Refers to the exhausted drug.

Your rating on answers to Lecture 3 *is* 85 *per cent.*

The abbreviations "P.," "Col." and Par.," are used to indicate "page," "column," and "paragraph," respectively.

In rating the answers, your *general understanding of the subjects* and the *appearance of your paper*, are also taken into consideration.

☞ The above questions should be *carefully reviewed* upon receipt of corrections. If questions to any other Lectures remain unanswered, please send them in at once.

THE DIRECTOR.

Always continue to answer in the regular order without waiting for delayed observations. Corrections are always forwarded as promptly as possible.

☞ NOTICE.—Do not fail to write your name, full address and CLASS page 654, at the TOP of the first page of your answers.

In all correspondence the CLASS page must be stated in order to insure prompt attention.

Pharmacopœial Preparations.

Nearly five hundred preparations officinal in the U. S. Pharmacopœia are termed *pharmaceutical*, because essentially within the art of the pharmacist; they are also frequently designated as *Galenic*, since their production involves no chemical processes.

They may be divided into three great classes with reference to the arts required for their production as follows:

1. Solutions and mixtures.
2. Products by extraction.
3. Mixtures of solids to assume various forms.

SOLUTIONS.

Solutions are classified with reference to the solvents employed, into *aqueous*, *alcoholic*, *acid* and *vinous* preparations, and *glycerites* and *syrups*.

Aqueous embrace the Waters, Liquors and Mucilages.

The officinal waters are divided into three kinds:

(1.) Pure waters.

Aqua and Aqua Distillata. See U. S. P. for tests of purity and for preparation of the latter.

(2.) Chemical waters.

Aqua ammoniæ.....containing 10 per cent. NH_3
" ammoniæ fort. " 28 per cent. NH_3
" chlori " 0.4 per cent. Cl

These are obtained by saturating water with the gases.

(3.) Medicated waters

Are saturated solutions of essential oils in distilled water; the only exception being Aqua Creasoti.

The solution of the oil is effected by adding it to twice its weight of absorbent cotton, distributing it thoroughly. The cotton is then packed in a funnel and percolated with the required quantity of water.

The following are officinal:

	Parts of oil in 1,000; or number of drams in 8 pints.
Aqua amygdalæ amaræ	1
" anisi	2
" cinnamomi	2
" creasoti	10
" foeniculi	2
" menthæ piperitæ	2
" " viridis	2
" camphoræ (dissolved in alcohol)	8

Medicated waters are also prepared by distilling the drug with water; the volatile oil escaping with the water and condensing with it, a saturated solution of the oil is obtained. Since this process gives better results than any other, it should be given the preference. The following are directed to be distilled:

	Parts of drug to 100 of distillate.
Aqua aurantii florum	40
" rosæ	40

The aromatic waters may also be prepared by disolving the oil, dropped upon a piece of filter paper, in hot water and filtering when cold.

LIQUORS.

Liquors are prepared either by simple solution of the solid in water, or by chemical decomposition of different substances in water, new compounds being formed in the solution.

Simple solutions are the following, officinal:

	Per cent.	In one fluid oz. grains.
Liquor acidi arseniosi	1.	4.6
" calcis	0.15	0.67
" pepsini (glycerin 40.)	4.	20.

Liquor Gutta Percha is a saturated solution of the latter in chloroform.

Chemical solutions or *liquores* are a very important class of preparations. To prepare them, however, requires considerable chemical knowledge and experience and appropriate apparatus.

The following are officinal in the U. S. P. (which see for description of process and formulas):

	Per cent by weight.
Liquor Ammonii acetatis	7.6
Arsenic et. hydrargyri. iodidi, of each	1.
Ferri acetatis	33.
Ferri chloridi, anhydrous salt	37.8
Ferri citratis "	35.5
Ferri et. quininæ cit. "	38.5
Ferri nitratis	6.
Ferri subsulphatis	43.7
Ferri tersulphatis	28.7
Hydrargyri nitratis	50.
Iodi comp (Potassium iodide 10)	5.
Magnesii citratis	
Plumbi subacetatis	25.
Plumbi subacetatis dilutus—of the concencentrated solution	3.
Potassæ	5.
Potassii arsenitis (of arsenic)	1.
Potassii citratis	9.
Sodæ	5.
Sodæ chloratæ (Cl.)	2.
Sodii arseniatis (dry)	1.
Sodii silicatis	
Zinci chloridi	50.

For liquors, officinal in the British Pharmacopœia and frequently prescribed, see U. S. Disp.

Mucilages are prepared by dissolving the solid substance in water and straining.

The following are officinal:

	In 100 parts.
Mucilago Acaciæ	34
Cydonii (dist. water)	2
Sassafras medullæ	2
Tragacanthæ (glycerin 18)	6
Ulmi (hot water)	6

SPIRITS.

Alcoholic solutions of volatile substances are termed *spirits*. Three classes of spirits are officinal:

1. Natural spirits:

Spirit frumenti, containing...50 per cent. alcohol.
" vini gallici " ...45 " "
For tests see U. S. P.

2. Solutions and aromatic spirits or "essences" (solutions of ethereal oils in alcohol).

		Per cent by weight.
Spiritus Ætheris		30
Ætheris comp.	ether	30
	ethereal oil	3
Ammoniæ aromat	ammonium carb	4
	ammonia water	10
	lemon oil	1.2
	lavender oil	.1
	pimento oil	.1
Anisi—oil		10
Aurantii—oil		6
Camphoræ		10
Chloroformi		10
Cinnamomi—oil		10
Gaultheriæ—oil		3
Juniperi—oil		3
Juniperi comp.	juniper oil	0.2
	caraway oil	0.02
	fennel oil	0.02
Lavandulæ—oil		3
Limonis (with fresh lemon peel)—oil		6
Menthæ piperitæ (with green herb) oil		10
Menthæ viridis—oil		10
Myrciæ	myrcia oil	0.9
	orange oil	0.06
	pimento oil	0.06
Myristicæ—oil		3
Odoratus (cologne), for formula see U. S. P.		

3. Chemical spirits.

Spiritus Ætheris nitrosi (nitrous ether)	5
Ammoniæ	10

Prepared by distillation. (For working formula see U.S.P.)

Solutions.—Syrups.

OLEATES.

Oleates, as officinal preparations, are oleates in solution of oleic acid in excess, and are distinct from the true solid oleates which are definite chemical compounds. Only two oleates are officinal:

	In 100 parts.
Oleatum hydrargyri (yellow oxide mercury)	10
" veratrinæ	2

Solution is effected by trituration in a mortar at a temperature not exceeding 165° F.

The chemical oleates will be considered under soaps, to which class they belong chemically.

WINES.

The vinous preparations include the natural wines and the medicated wines made with stronger white (sherry) wine, containing 25 per cent. alcohol, which aids in their preservation.

The following wines are officinal:

Natural Wines:

Vinum album containing 10 per cent. alcohol.
" " fortius " 20–25 " "
by adding 12.5 per cent. of alcohol to ordinary sherry wine.

Vinum rubrum ..... 10 per cent. alcohol.

Medicated wines—prepared by solution:

	In 100 parts.
Vinum Antimonii—antimony and potassium tart.	0.4
Ferri amarum—sol. iron, quin. cit.	8.
Ferri amarum—tinct. sweet orange	12.
Ferri amarum—syrup	36.
Ferri citratis—iron ammon. cit.	4.
Ferri citratis—tinct. sweet orange	12.
Ferri citratis—syrup	12.
Ipecacuanhæ—fl. ext. ipecac	7.

The other officinal wines are treated under products by extraction.

GLYCERITES.

Glycerites or glyceroles are solutions in glycerin. Only two are officinal:

	In 100 parts.
Glyceritum amyli	10
" vitelli (egg yolk)	45

The first mentioned is prepared by heating the mixture gradually to 284° F., when the starch globules are ruptured and solution is effected.

Several additional glycerites were formerly officinal, but were discarded in the U. S. P. '80.

SYRUPS.

Syrups are nearly saturated solutions of sugar in water, in which medicinal substances are dissolved.

Syrupus or simple syrup is a saturated solution of sugar in distilled water in the proportion of 65 parts of sugar to 35 parts of water (by weight).

The sugar is dissolved in the water by heat, the solution strained, and sufficient water added through the strainer to make a product of the sp. gr. 1.31, or of such strength that *one gallon* shall weigh about 11 *av. pounds*, (7 lbs. sugar to the gallon).

The officinal syrups are divided into such respectively as are obtained (1) by simple solution, (2) by extraction and (3) by chemical processes, when they are called chemical syrups.

To the first-class (prepared by mixing a solution of the drug with syrup) belong:

	In 100 parts by weight.
Syrupus Acaciæ—mucilage acacia	25
Acidi citrici—acid citric	0.8
Acidi citrici—sp. lemon	0.4
Aurantii florum—orange flower water	35
Ipecacuanhæ—fluid extract	5
Krameriæ—fluid extract	35
Lactucarii—fluid extract	5
Rhei aromaticus—tincture	10
Rosæ—fluid extract	10
Rubi—fluid extract	20

Also the following with slight modifications to insure clear solutions:

Syrupus Senegæ	fluid extract	16
	ammonia water	0.4
Zingiberis...—fluid extract		2

In syrup of senega the fluid extract is mixed with water and the ammonia water, filtered and the sugar dissolved in the filtrate. A clear syrup is thereby obtained, as the pectin contained in the senega would precipitate if the fluid extract were simply mixed with the syrup without first being diluted with water, and filtered.

Prepared by extraction are:

	In 100 parts by weight.
Syrupus Allii (extracted with dil. acetic acid)	15
Althææ	4
Amygdalæ—sweet almonds	10
Amygdalæ—bitter "	3
Amygdalæ—orange fl. water	5
Aurantii—tincture	5
Limonis—lemon juice	40
Limonis—" peel	2
Picis liquidæ	6
Pruni virginianæ (glycerin 5)	12
Rhei—rhubarb	9
Rhei—potass. carb	0.6
Rhei—cinnamon	1.8
Rubi idæi—raspberry juice	40
Sarsaparillæ comp.—sarsaparilla	15
Sarsaparillæ comp.—guaiac wood	2
Sarsaparillæ comp.—pale rose	1.2
Sarsaparillæ comp.—glycyrrhiza	1.2
Sarsaparillæ comp.—senna	1.2
Sarsaparillæ comp.—anise 0.6, gaultheria 0.6, sassafras 0.6	1.8
Scillæ—vinegar squills	40
Scillæ comp.—squill	6
Scillæ comp.—senega	6
Scillæ comp.—tartar emetic	0.15
Sennæ—fluid ext	33
Sennæ—oil coriander	
Tolutanus	4

The *chemical* syrups are a very elegant class of preparations, their usefulness having been officially recognized by the introduction of seven in the U. S. P. '80 (syrup ferri iodidi being old).

	In 100 parts by weight.
Syrupus Acidi hydriodici	1
Calcis lactophosphatis	2.5
Calcis	5
Ferri bromidi—ferrous bromide	10
Ferri iodidi—ferrous iodide	10
Ferri quininæ and strychninæ phosphatum—iron phosphate	1.33
Ferri quininæ and strychninæ phosphatum—quinine	1.33
Ferri quininæ and strychninæ phosphatum—strychnine	0.04
Ferri quininæ and strychninæ phosphatum—acid phosphor.	8
Hypophosphitum—calcium hy'phos	3.5
Hypophosphitum—sodium "	1.2
Hypophosphitum—potassium "	1.2
Hypophosphitum—spirit lemon	.2
Hypophosphitum—acid citric	.1
Hypophosphitum c. ferro—iron lactate....(in syr. hypophos)	1

Honeys are not an important class; they comprise:

Mel or crude honey.

Despumatum or clarified honey.

Rosæ—Honey of rose, prepared from an extract made with dilute alcohol from 8 parts red rose to 92 parts clarified honey.

ELIXIRS.

Elixirs are a class of elegant preparations similar to wines or cordials, composed of water, sugar, alcohol and aromatics. The medicinal substances are usually in such proportion that an ordinary dose may be contained in one or two teaspoonfuls of the elixir.

Mixtures.

ELIXIRS.

Elixir Aurantii.—Elixir of orange or simple elixir is the only preparation of this class officinal:

Oil of orange	part	1
Cotton	parts	2
Sugar granul	"	100
Alcohol	"	50
Water	"	150
To make	parts	300

The oil distributed on the cotton is percolated with the alcohol and water previously mixed; in the percolate the sugar is dissolved without heat and strained. With ounces (av.) for parts in this formula the quantity of product is about two gallons. This elixir contains about 22 per cent. (by vol.) alcohol.

Owing to the great variation in formulas for unofficinal elixirs none are here given.

The manner of preparing the more simple kinds of elixirs corresponds with that for syrups of the same class, viz: mixing the drug in a fluid form with the elixir (simple). Elixirs, however, do not contain nearly as large a proportion of sugar as syrup, but relatively more water, and therefore do not have the density of the latter, which causes precipitation when mixed with fluid extracts weak in alcohol.

MIXTURES.

Mixtures in pharmacy are preparations in which solid or insoluble substances are suspended in water, usually by the intervention of some mucilaginous or syrupy substance, as for example, in emulsions.

They are generally prepared by incorporating the medicinal substance with the intermedia, such as acacia, sugar, etc., in a mortar, the water being gradually added. The term *mistura* is given to some solutions, which cannot be better classified, owing to their complicated composition.

The following are officinal, but must be prepared freshly when wanted—extemporaneously—since they readily ferment or otherwise spoil:

		In 100 parts.
Mistura Ammoniaci		4
Amygdalæ	almonds	6
	sugar	3
	acacia	1
Asafœtidæ		4
Chloroformi	chloroform	8
	camphor	2
	egg-yolk	10
Cretæ	chalk powd. comp.	20
	cinnamon water	40
Ferri comp.—ferrous carb (Griffith's mixture.)		2
Ferri ammonii acetatis—about (Basham's mixture.)		1
Glycyrrhizæ comp.	ext. glycy. purc.	3
	sugar	3
	acacia	3
	tr. opium camph.	12
	wine antimony	6
	spir. nitrous ether	3
Magnesiæ et asafœtida (Dewee's carminative.)	magn. carb	5
	tinct. asafœtida	7
	" opium	1
	sugar	10
Potassii citratis (from lemon juice)		10
Rhei et sodæ	sodium bicarb	3
	fl. ext. rhubarb	3
	spirit peppermint	3

LINIMENTS.

Liniments, owing to their variable composition, are classed with the mixtures; some are liquid soaps, others are solutions.

The following are officinal:

		In 100 parts.
Linimentum Ammoniæ—in cottonseed oil—ammon. water		30
Belladonnæ (fl. ext.) with camphor		5
Calcis—in cottonseed oil—solution of		50
Camphoræ—in cottonsced oil—camphor		20
Cantharides—in oil turpentine—cantharides		15
Chloroformi—in soap liniment—chloroform		40
Plumbi sub. acct—in cottonsced oil—solution of		40
Saponis	soap	10
	camphor	5
	oil rosemary	1
	alcohol	70
	water	
Sinapis comp	vol. oil mustard	3
	extract mezereum	2
	camphor	6
	castor oil	15
	alcohol	
Terebinthinæ—in oil turpentine—resincerate		65

Products by Extraction.

The preparations obtained *by extraction* embrace the largest classes of Galenic medicine, viz.: Infusions, Decoctions, Vinegars, Wines, Tinctures and Fluid Extracts; also Extracts, Abstracts, Resins and Oleoresins.

INFUSIONS.

Infusions are prepared by macerating the drug n a coarse powder for two hours in water, and expressing the liquid.

The following are prepared by heat:

		In 100 parts.
Infusum Brayeræ		6
(To be dispensed *without* straining.)		
Digitalis	digitalis	1.5
	Cinnamon	1.5
	Alcohol	7.5
Sennæ comp.	senna	6
	fennel	2
	magnes. sulph.	12
	manna	12

Prepared *without* heat:

Infusum Cinchonæ (acid sulph. arom. 1)	6
Pruni virginianæ	4

Unofficinal infusions when not otherwise directed are prepared 10 parts of the drug in 100 parts of the infusion (about 6 drams to 8 fl. ounces).

DECOCTIONS.

Decoctions are prepared by boiling the drug in coarse powder, in water, expressing the liquid and straining; when the strength is not specified, they are made to represent 10 parts of drug. in 100.

The following are officinal:

		In 100 parts.
Decoctum Cetrariæ		5
Sarsaparillæ comp.	sarsaparilla	10
	sassafras	2
	guaiacum w'd.	2
	glycyrrhiza	2
	mezereum	1

VINEGARS.

Vinegars are solutions of vegetable drugs in diluted acetic acid *of the uniform strength of ten per cent. by weight.* They are made by maceration and percolation. The following are officinial:

	Grains in one fl. oz.
Acetum Lobeliæ	45
Opii	50
Sanguinariæ	45
Scillæ	47

Wines.—Tinctures.

WINES.

Wines prepared by extraction, the process employed being maceration or percolation, or both, are the following, the menstrua being stronger white wine:

		In 100 parts.
Vinum Aloes	aloes	6
	cardamom	1
	ginger	1
Aromatic—absinthium, lavender, origanum, rosemary, peppermint and sage, of each one part.		6
Colchici radicis		40
Colchici seminis		15
Ergotæ		15
Opii	opium	10
	cinnamon	1
	cloves	1
Rhei	rhubarb	10
	calamus	1

TINCTURES.

Tinctures are the simplest form of alcoholic preparations obtained by extraction. They are prepared by maceration and filtration; also by percolation and a few by solution.

By *maceration* and *filtration*, those containing resins and oleoresins, musk, opium and tinctures of fresh herbs.

By *percolation*, when prepared from dried vegetable drugs, i. e., barks, leaves, roots, etc., usually after brief maceration.

By *solution*, or by mixing different solutions with the menstrua, i. e., acetate and chloride iron, iodine.

Syllabus of the officinal tinctures.	Part of Plant or Drug.	Menstrua for 100 Parts by Weight. Water	Alcohol	
Containing 5 *per cent.*—				
Tinctura cantharidis	insect		100	
" capsici	fruit.	5	100	
Containing 8 *per cent.*—				
Tinctura iodi	non-metal		92	
Containing 10 *per cent* —				
Tinctura arnicæ radicis	root	50	50	
" bryoniæ	"		100	
" calumbæ	"	40	60	
" chiratæ	herb	50	50	
" cinnamomi	bark	40	60	
" croci	stigma	50	50	
" cubebæ	fruit	50	50	
" ignatiæ	seed	11	89	glycerin. 15.
" kino	insp. juice	17	68	
" matico	leaves	50	50	
" moschi	secretion	50	50	
" opii	insp. juice	50	50	
" opii deod	"	80	20	
" physostigmatis	seed		100	
" quassiæ	wood	50	50	
" serpentariæ	rhizome	50	50	
" stramonii	seed	50	50	
" sumbul	root		100	
" tolutana	balsam		100	sugar 20.
" vanillæ	fruit	27	53	
Coutaining 15 *per cent.*—				
Tinctura belladonnæ	leaves	50	50	
" cardamomi	fruit	50	50	
" colchici	seed	50	50	
" conii	fruit	50	50	HCl dil, 0.4
" digitalis	herb	50	50	
" gelsemii	rhizome		100	
" hyoscyami	leaves	50	50	
" sanguinariæ	rhizome	33	67	
" scillæ	bulb	50	50	
" rhei	root	50	50	
cardam., p'ts, 12 / rhubarb " 2				
Containing 40 *per cent.*—				acid
Tinctura aconiti	tuber		100	tart. 0 4
Containing 50 *per cent.*—				
Tinctura veratri viride	rhizome		100	

Syllabus of tinctures (concluded.)	Part of Plant or Drug.	Menstrua for 100 Parts by Weight. Water	Alcohol
Containing 20 *per cent.*—			
Tinctura arnicæ florum	flowers	50	50
" asafœtidæ	gum-resin	..	100
" aurantii amari	rind	50	50
" aurantii dulcis	"	..	100
" benzoini	gum-resin	..	100
" calendulæ	herb	50	50
" cannabis Ind	"	..	100
" cimicifugæ	rhizome	..	100
" cinchonæ [glycerin 10]	bark	25	65
" gallæ [glycerin 10]	excresc.	45	45
" guaiaci	gum-resin	..	100
" guaiaci ammon	"	..	....
[mens, spirit ammon. arom.]			
" humuli	strobiles	50	50
" hydrastis	rhizome	50	50
" krameriæ	root	50	50
" lobeliæ	herb	50	50
" myrrhæ	gum-resin	..	100
" *nucis vomicæ	seed	11	89
" pyrethri	root	..	100
" valerianæ	rhizome	33	67
" valerianæ ammon	"		
[menst. spirit ammon. arom.]			
" zingiberis	"		100

Compound tinctures (showing parts of drug in 100 by weight.)

Tinctura aloes	aloes 10, ext. glycyr. 10	50	50	
" aloes et myrrhæ	aloes 10, myrrh 10	....	100	
" benzoini comp	benzoin. 12, aloes 2, storax 8, tolu 4	....	100	
" cardamomi comp	cardamom. 2, cinnamon 2, caraway 1, cochineal 5	†	47	47
" catechu	catechu 12, cinnamon 8	50	50	
" cinchonæ comp	red cinchona 10, bitter orange 8, serpentaria 2	†	10	80
" herbar. recenti	the fresh herb 50	....	q. s.	
" ferri acetatis	sol. acet. iron 50, acetic ether 20	....	30	
" ferri chloridi	solution iron chloride 35	....	65	
" gentianæ comp	gentian 8, bitter orange 4, cardam 2	50	50	
" ipecac. et opii	tinct. opii deod 100, fl. ext. ipecac 10	....	ev. q. s.	100
" lavandulæ comp	oil lavend. .8, oil rosmar .2, cinnamon 1.8, cloves .4, nutmeg 1.0, red saunders .8	27	68	
" opii camphorata	opium p. .4, ac. benz. .4, camphor. .4, oil anise .4	†	48	48
" rhei aromaticæ	rhubarb 20, cinnam 4, cloves 4, nutmeg 2	50	50	
" rhei dulcis	rhubarb 8, glycyrrh 4, anise 4, cardamom 1	50	50	
" saponis viridis	green soap 65, oil lavend 2	....	q. s.	

*This tincture is made of such strength that it will contain two parts of dry extract. The percentage of extract obtained from nux vomica with alcohol of this strength is 10 per cent. (or more); this process has been devised to determine whether or not the drug has been exhausted, as nux vomica is difficult to extract.

†With glycerin sufficient to make 100 parts.

Fluid Extracts.

Fluid Extracts may be defined as a class of concentrated tinctures of such strength as to represent the drug *volume for weight.*

The fluid extracts of the U. S. P. 1870 represented one grain of drug in one minim, or one troy ounce in one fluid ounce. In the U. S. P. 1880 the standard adopted is *one gram* in *one cubic centimeter*, which reduces the strength *five per cent.* (see Preface U. S. P. 1880, page xxx.) The variation in sp. gr. in this class of preparations was so great as to preclude the construction of the formulas according to *parts by weight*, thus leaving fluid extracts the only exceptions to that system in the U. S. P.

Fluid extracts are made by *percolation*, *maceration* or *digestion* and *expression*. [See Lecture III.] With few exceptions they cannot be prepared by simple percolation without evaporation to concentrate the percolate to the required measure.

The following are the processes employed:

A. In proceeding to percolate one hundred grams of the drug, according to directions [Lecture III, page 30], the first 80 to 90 cubic centimeters are reserved, and percolation continued until the exhaustion is completed. The weak percolate is evaporated to a soft extract (the alcohol being recovered) and dissolved in the reserved percolate. Sufficient of the menstruum is then added to make the product measure 100 C.c.

The official proportions for menstrua are parts by *weight*, as given in the following tables. Since the quantity of product obtained is by *measure*, however, the quantity of menstrua as obtained by weight differs in volume according to its specific gravity.

Menstrua—Alcohol (94 per cent. by volume).

		DRUG.	NO. POWDER.
Extractum aromaticum	fluidum	aromatic powder	60
" belladonnæ	"	root	60
" brayeræ	"	flowers	40
" calami	"	root	60
" cannabis Ind.	"	herb	20
" capsici	"	fruit	60
" cimicifugæ	"	root	60
" cubebæ	"	berry	60
" cypripedii	"	rhizome.	60
" eucalypti	"	leaves	40
" gelsemii	"	root	60
" lupulini	"	glands	—
" mezerii	"	bark	30
" sabinæ	"	tops	40
" sanguinariæ	"	rhizome.	60
" scillæ	"	bulb	20
" veratri viridis	"	rhizome.	60
" xanthoxyli	"	bark	40
" zingiberis	"	rhizome.	40

Menstrua—Alcohol 3 parts, water 1.

Extractum digitalis	fluidum	leaves	60
" grindeliæ	"	herb	30
" guaranæ	"	seed	60
" hydrastis	"	rhizome	60
" hyoscyami	"	leaves	60
" iridis	"	rhizome	60
" podophylli	"	" "	60
" rhei	"	root	30
" serpentariæ	"	rhizome	60
" stramonii	"	seed	40

Menstrua—Alcohol 8 parts, water 1.

Extractum nucis vomicæ	fluidum	seed	60

Menstrua—Alcohol 2 parts, water 1.

Extractum aurantii amar.	fluidum	rind	40
" buchu	fluidum	leaves	60
" colchici radicis	"	rhizome	60
" colchici seminis	"	seed	30
" senegæ	"	root	40
" valerianæ	"	rhizome	60
" viburni	"	bark	60

Menstrua—Diluted alcohol. (alcohol 1 part; water 1 part.)

			DRUG.	NO. OF POWDER.
Extractum	arnicæ radicis	fluidum	root	60
"	columbæ	"	" "	20
"	dulcamaræ	"	twigs	60
"	erythroxyli	"	leaves	40
"	eupatorii	"	herb	40
"	gentianæ	"	root	30
"	lobeliæ	"	herb	60
"	pilocarpi	"	leaves	40
"	quassiæ	"	wood	60
"	rumicis	"	root	40
"	spigeliæ	"	rhizome	60
"	stillingiæ	"	root	40

Menstrua—Alcohol, 2 parts; water; 3.

Extractum taraxaci	fluidum	root	30

Menstrua—Alcohol, 3 parts; water, 4.

Extractum sennæ	fluidum	leaves	30

Menstrua—Alcohol, 1 part; water, 2.

Extractum frangulæ	fluidum	bark	40
" hamamelidis		leaves	40
" scutellariæ	fluidum	herb	40

Menstrua containing glycerin.—

Alcohol and glycerin.—		DRUG.	NO. OF POWDER.	GLYCERIN IN 100 PARTS BY WEIGHT.
Extractum cinchonæ	fluidum	bark	60	25
" gosypii rad	"	"	30	30
Diluted alcohol and glycerin.				
Extractum chimaphilæ	fluidum	leaves	30	10
" chiratæ	"	root	30	10
" cornus	"	bark	60	20
" geranii	"	rhizome	30	10
" krameriæ	"	root	40	20
" leptandræ	"	rhizome	60	15
" pareiræ	"	root	40	20
" rhois glabræ	"	leaves	40	10
" rosæ	"	"	30	10
" uvæ ursi	"	"	30	10

Menstrua containing *Alcohol, water, and glycerin in various proportions.*	DRUG.	MENSTRUA FOR 100 PARTS BY WEIGHT. Alcohol.	Water.	Glycerin.
Extractum matico fluidum	leaves	75	25	10
" rubi "	root-bark	45	35	20
" pruni virginianæ fluid	bark	25	55	20
" sarsaparillæ fluid	root	30	60	10
" sarsaparillæ fluid comp.	sarsaparilla .75; glycyrrhiza .12; sassafras .10; mezereum 3	30	60	10

Repercolation or simultaneous fractional percolation, by employment of which the use of heat for concentrating the percolate is avoided, may be used to advantage, when the quantity operated upon is large.

B. In some drugs, the active principles are fugitive or liable to dissociation by the heat employed in evaporating the weak percolate. In such cases an acid is added, just previous to the evaporation, which combines with the alkaloid and forms salts not so readily volatilized. To this class belong:

	DRUG.	MENSTRUA FOR 100 PARTS BY WEIGHT. Alcohol.	Water.	Acid Hcl. dil.
Extractum conii fluidum	fruit.	50	50	3
" ergotæ "	sclerot.	40	54	6

C. When the active principles are extracted with difficulty by the use of ordinary solvents (neutral menstrua), *acid* menstrua are employed for the extraction of alkaloids; *alkaline* for acids.

Two of this class are officinal.

		MENSTRUA FOR 100 PARTS BY WEIGHT. Drug.	Alcohol.	Water.	Tart. acid.
Extractum aconiti	fluid	tuber	100	.....	1
" glycyrrhizæ	"	root	47	47	aq. am. 6

Fluid Extracts.—Extracts.

FLUID EXTRACTS—(CONTINUED).

D. To prevent precipitation or gelatinization, a substance may be added previous to evaporation, as in the following (officinal):

		Menstrua for 100 parts by weight.		
	Drug	Alcohol.	Water.	Aq. am.
Extractum senegæ fluidum	root	65	33	2

E. In a few drugs the active principles are, while soluble in water, not easily extracted by watery menstrua. Alcohol or alcoholic menstrua are therefore used in the extraction, but these also extract principles either inert or undesirable, because they are insoluble in water or watery solutions, such as syrups, with which it is required they shall mix clear. The fluid extract is freed from matter insoluble in water, without sacrificing its strength in active principles, by the following process, as applied to the only officinal fluid extract of this class:

Extractum ipecacuanhæ fluidum.—

One hundred grams of ipecac is exhausted with alcohol by percolation. The alcohol is distilled from the percolate until reduced in volume to 50 C.c., or about one-half the quantity of drug, measure for weight. To this is added 100 C.c. of water and the mixture evaporated to 75 C.c.; when perfectly cold, filter, washing the insoluble matter on the filter with water, until perfectly tasteless. This is again evaporated to 50 C.c. with the washings, allowed to cool, filtered if necessary, and alcohol added to make the product measure 100 C.c.

A fluid extract of sarsaparilla compound for making syrup is also prepared by this process.

F. When the active principles are readily soluble in water and the drug is very cellular, extraction is effected by digestion and expression. This method must be applied only to drugs whose virtues are not impaired by the heat necessary to concentrate the expressed liquid to the required measure.

To exhaust drugs with water, maceration and expression are always necessary, because the cell-walls swell, and the water acts upon starch and gummy matter, thus impeding the flow in percolation. A greater proportion of solvent is also necessary than in the process of percolation, hence the necessity for the evaporation of the liquid extract. Since water, especially when hot, extracts matter causing fermentation, the liquid is evaporated to a measure corresponding to 80 per cent. of the drug used (80 C.c. for 100 grams of drug); to this when cold, 20 per cent. (20 C.c.) of alcohol is added, and after standing some time, filtered; then alcohol of 20 per cent. added to make up the measure. The easily fermentable substances are insoluble in liquids containing 20 per cent. alcohol, and are precipitated and freed from the extract by filtration. The alcohol also acts as a preservative, since aqueous solutions of vegetable substances do not keep for any length of time.

Two of this class are officinal:

Extractum castaneæ fluidum*.....leaves
" tritici fluidum .....rhizome

Extractum ergotæ purif. or "liquid ergot" and ergotin, may be prepared by this process.

SOLID EXTRACTS.

Extracts, or "solid" extracts as they are termed, to distinguish them from fluid extracts, are the soluble active principles of vegetable drugs, concentrated by evaporation to a soft solid, or a plastic mass of pilular consistence.

*Owing to the great proportion of extractive in castaneæ, the officinal process is somewhat modified. [See U. S. P.]

The strength of an extract depends upon the amount of the crude drug it represents. Hence, were the medicinal strength of the drug uniform, the percentage of extract obtained from it should always bear a definite relation to the drug.

For example: Ten grains of extract are obtained from 100 grs. nux vomica by the officinal menstruum; 1 grain of the extract represents, therefore, 10 grains of the drug, and the dose of the extract is estimated accordingly.

By the use of more aqueous menstruum, however, a much greater proportion of extract is obtained, viz.: with alcohol of 60 per cent., 16 grains of extract from 100 grains of nux vomica. The strength of this extract is much less, as one grain represents only (100 divided by 16) 6¼ grains of the drug. If the drug is of uniform strength and the exhaustion with either menstrua complete, the quantity of extract obtained will be very irregular and correspondingly variable in strength.

As a general rule, the more *aqueous* the menstrua the *greater* the yield of extract; conversely, the more *alcoholic* the menstrua the *smaller* the yield of extract. To obtain the extracts, therefore, of officinal strength it is necessary to use officinal menstrua in the extraction.

The percentage of extract obtained from the drug is appended below, and will be found more nearly accurate than in any similar published table; from these the *quantity of drug represented by one grain of extract* (and the *dose* also when that of the crude drug is known) may be calculated by dividing the percentage in 100, as shown above:

	Percentage of Extract from Drugs.
Extractum Aconiti*	20
Arnicæ radicis*	20
Belladonæ alc*	22
Cannabis Indicæ*	10
Cinchonæ*	16
Colocynthidis	18
Conii*	25
Digitalis*	25
Ergotæ	20
Euonymi*	20
Hyoscyami alc	17
Iridis	20
Jugandis*	15
Leptandræ*	18
Mezerii	10
Nucis vomicæ	10
Physostigmatis	2.5
Podophylli	10
Rhei	35
Stramonii (seed)	15
The following are extracted by water:	
Extractum Aloes aquosa	50
Colchici	35
Gentianæ	30
Glycyrrhizæ purum	40
Hæmatoxylon	25
Krameriæ	30
Malti	60
Opii*	55
Quassiæ*	2.5
Taraxaci	30

Extractum Colocynthidis comp. is the only compound extract officinal:

	Parts.
Extract Colocynth	16
Resin of scammony	14
Soap, powdered	14
Aloes	50
Cardamom	6
Alcohol to make	100 parts.

*These contain the addition of 5 per cent. of glycerin, to preserve the pilular consistence of the extract.

Abstracts.—Oleoresins.—Resins.

ABSTRACTS.

Abstracts or powdered extracts, are prepared from the extracts by the addition of sufficient milk sugar to make the product represent *twice its weight* of the crude drug.

Abstracts, therefore, always bear a uniform relation to the drug, viz: *One grain represents two grains of the drug*, just as the fluid extracts bear the uniform relation of representing the drug *measure* for *weight*.

This feature alone should favor the employment of abstracts in preference to the extracts, since they do not share the variability in strength of the extracts, the dose of the abstract being exactly one-half that of the crude drug or fluid extract. Unfortunately this advantage is, on the other hand, offset by the disadvantage that abstracts are more bulky and therefore more inconvenient to administer. That they are more bulky than solid extracts is readily seen, but since the abstracts with two or three exceptions, contain only the *minimum* quantity of inert matter, which will prevent them from caking, their greater bulk as compared with the so-called "powdered" extracts, is more imaginary than real.

A properly prepared abstract represents quite as fully the medicinal strength of the drug as a powdered extract, *grain for grain*, the latter class containing inert matter in nearly as large a proportion as the abstracts, although it is claimed that they are of the same strength as the recent extracts. Those abstracts which contain 40 per cent. of extract, at least (20 per cent. from the drug), may, therefore, be dispensed with perfect safety in place of the "powdered" extracts.

In *preparing* an abstract the drug is exhausted with proper menstruum and the extract obtained; this, while yet warm, is incorporated with its weight of milk sugar (powdered) and set in a warm place. When sufficiently dry the mixture is powdered and enough milk sugar added to bring the product to one-half the weight of the drug employed. Abstracts must be preserved in small, perfectly dry and well-corked vials in a dry and cool place.

From the table the number of grains of abstract equivalent to one grain of extract is calculated by dividing the extract percentage into 50.

The following are officinal:

	Percentage of Extract from Drug.
ABSTRACTUM—	
Aconiti	20
Belladonnæ (root)	20
Conii (fruit)	25
Digitalis	25
Hyoscyami	17
Ignatiæ	10
Jalapæ	17
Nucis vomicæ	10
Podophylli	10
Senegæ	35
Valerianæ	12.5

Extract Jalap has been discarded in the U. S. P. '80. It was prepared with aqueous menstruum, the yield being 50 per cent.; the abstract is therefore of the same strength, but an alcoholic menstruum being used, the percentage of extract is much smaller as shown above. Strong alcohol being used in the extraction of valerian explains the small percentage of extract which is only half that obtained in the extract of the U. S. Pharmacopœia 1870.

OLEORESINS.

Oleoresins are semi-liquid extracts, obtained by extraction with ether as a menstruum.

Ether extracts *fixed* and *volatile oils* from drugs, as well as *resin*; these principles constitute therefore the oleoresins which sometimes also contain other active matter in solution or suspended.

The menstruum (ether) being easily volatilized, is recovered by distillation; it is sometimes superseded by alcohol, which yields an extract very similar to that obtained with ether.

The following are officinal:

Oleoresina aspidii	Oleoresina lupulini
" capsici	" piperis
" cubebæ	" zingiberis

RESINS.

Resins.—When a concentrated tincture of a resinous drug is poured into a large quantity of cold water some of the extractive matter becomes insoluble and is precipitated; this, after being washed, dried and powdered, is termed a *resin*.

Resins are usually *soluble in alkalies* and *insoluble in acids* (dilute); for this reason the water used for precipitation is sometimes rendered slightly acid to favor the separation.

The following are officinal:

Resina jalapæ—precipitated in water.
" scammonii " "
" podophylli " in acidulated water.

Resins are also obtained as by-products in the distillation of oils, being left in the still after the oil, which held them in solution, has volatilized.

Of this class two are officinal: Resina and R. Copaibæ.

The terms *resin*, *resinoid* and *concentration* are also applied to a class of preparations used by eclectic physicians, prepared by this general process with some modifications. (See U. S. and Am. Disp.)

POSOLOGY.

After due deliberation it was deemed best not to incorporate the doses in the tables of preparations.

In the preparation of medicines the greatest accuracy is necessary and adherence to *quantities* is of the utmost importance, in order that preparations of definite strength only, may be obtained.

In dispensing, however, the greatest possible latitude is given the pharmacist by the prescriber so far as doses are concerned. For these reasons, while a correct knowledge of the *strengths* of all preparations is absolutely necessary to the pharmacist, a knowledge of their *doses* is essential primarily to enable him to guard against dispensing them in dangerous proportions.

The dose of a preparation must be based upon the dose of the crude drug, and estimated according to the quantity of drug it represents. It is therefore best to learn the dose of the drug itself, from which the dose of all preparations from it may be easily computed when the percentage strength is known. For example: If the dose of nux vomica be three grains, the dose of its preparations (the drug being taken as 1) would be as follows:

	Quantity drug represented.	Dose.
Nux vomica, powder	1	3 grs.
" " extract fluid	1	3 min.
" " abstract	2	1½ grs.
" " extract	10	3-10 "

The doses of crude drugs will be given under their respective subjects.

Mixtures of Solids.

To this division belong most of the many compounds, in the preparation of which the pharmacist's knowledge and skill in the various arts are most largely called into play. They may be divided into two general classes:

(1) For internal use. (2) For external medication.

To the first class belong Powders, Triturations, Masses, Confections, Troches and Pills.

POWDERS.

Powders comprise two classes—simple and compound—the latter only being officinal:

Compound powders (*Pulveres Compositæ U. S. P.*)

Pulvis—		Parts in 100.
Antimonialis (James' Powder.)	antimony oxide	33
	calcium phosphate	67
Aromaticus	cinnamon	35
	ginger	35
	cardamon	15
	nutmeg	15
Cretæ compositus (For mist. cretæ)	chalk prep.	30
	acacia	20
	sugar	50
Glycyrrhizæ comp. (*Brust Pulver* Ger.)	senna	18
	glycyrrhiza	16
	fennel	8
	sulphur, washed	8
	sugar	50
Ipecacuanhæ et opii (Dover's powder)	ipecac	10
	opium	10
	milk sugar	80
Jalapæ compositus	jalap	35
	potass. bitartrate	65

		Parts in 60.
Morphinæ comp. (Tulley's Powder)	morphine sulph.	1
	camphor	20
	glycyrrhiza	20
	calc. carb. precip	20
Rhei compositus (Magnesia and rhubarb)	rhubarb	25
	magnesia	65
	ginger	10

		In each Powder, grains.
Effervescens comp. (Seidlitz powders)	sodium bicarb.	40
	potass. sod. tartr.	120
	acid tartaric	35

TRITURATIONS.

Triturations are powders diluted with milk sugar and thoroughly triturated in the proportion of *one* of the medicinal substances to *nine* of sugar of milk.

This diluted form is applicable in the administration of the more powerful remedies, and also convenient to the dispenser, because small quantities of alkaloids, etc., may be weighed with greater accuracy when so diluted, and more quickly mixed, owing to their fine division. The following is officinal:

Trituratio Elaterini prepared by mixing 10 parts of the alkaloid with 90 parts milk sugar. This preparation is more reliable than *elaterium*.

MASSES.

Masses are plastic mixtures obtained: (1) by incorporating the drug with adhesive substances, (2) by chemical reaction; (3) sometimes by both.

By the first process:

Massa Hydrargyri (Blue mass)	mercury	33
	glycyrrhiza	5
	althæa	25
	honey of rose	34
	glycerin	3

By the second process:

Massa Copaibæ	copaiba	94
	magnesia	6

Copaivic acid combines with the magnesia, forming magnesium copaivate.

By both these processes:

Massa Ferri Carbonatis (Vallet's Mass)	iron sulph.	100
	sodium carb.	110
	honey	38
	sugar	25
	syrup & water to make	100

By double decomposition between the iron sulphate and sodium carbonate, carbonate of iron is formed, which is incorporated with honey and sugar to prevent oxidation, and to render the mixture a plastic mass.

CONFECTIONS.

Confections may be defined as masses wherein the adhesive substance is sugar, and enters in larger proportions, serving as a *vehicle* for masking the taste of the drug.

Confections, when made by beating a fresh drug, first reduced to pulp with sugar until of the proper consistence, are termed *Conserves*. When applied to drugs requiring a different treatment, or to powders, they are also called *Electuaries*.

Only one representative of each class is officinal·

Confectio Rosæ (Conserve of roses)	red rose	8
	rose water	16
	sugar	64
	honey	12
Confectio Sennæ (*Electuar. e. sennæ* Ger.)	senna	10
	coriander	6
	cassia fistula	16
	fig	12
	tamarind	10
	prune	7
	sugar	50
	water to make	100

For details of manipulation, see U. S. P

TROCHES.

Troches or *lozenges* are confections made into various forms and then dried.

The vehicle or excipient consists of gum, sugar and flavoring, which is, in some cases, orange flower water; in others, tolu, nutmeg, vanilla, etc.

Troches are seldom prepared in the pharmacy, since they belong more to the confectioner's art, and are best prepared on a large scale. Besides, to produce lozenges elegant in appearance requires not only considerable experience, but also appliances especially adapted to their manufacture.

The following lozenges, weighing from 10 to 15 grains, are officinal (the column of figures showing number of grains of *active drug* in each):

Trochisci—		Flavor.
Acidi tannici	1	.orange.
Ammonii chloridi	2	.tolu.
Catechu	1	.orange.
Cretæ	4	.nutmeg.
Cubebæ (ext. glycyrrh. 4) oleoresin	½	.sassafras.
Ferri (oxide)	5	.vanilla.
Glycyrrhizæ et opii—ext. opium	1-20	.anise.
Ipecacuanhæ	¼	.orange.
Krameriæ (extract)	1	. "
Magnesiæ	3	.nutmeg.
Menthæ piperitæ (oil)	0.15	
Morphinæ sulph et ipecac.	1-40 morph. sulph, 1-13 ipecac	gaultheria.
Potassii chloratis	5	.lemon.
Sodii bicarbonatis	3	.nutmeg,
Sodii santoninatis	1	.orange.
Zingiberis (tincture)	2	.ginger.

Lozenges of peppermint, lemon, musk, vanilla and gaultheria may readily be prepared by saturating sugar lozenges with the respective essences or tinctures.

Pills.

Pills are spherical masses of medicinal substances rendered cohesive and firm in consistence by the addition of some adhesive (usually inert) substance, termed *excipient.*

The kind of excipient employed varies with the nature of the medicinal substance. As a general rule such substances are chosen as give to the mass with the smallest proportion the greatest plasticity, and also best preserve the spherical shape of the pills. The excipient must also, unless the contrary be directed for especial purposes, be indifferent in character to avoid change in the medicinal substance.

Drugs adapted for dispensing in the form of pills may be divided as follows:

(1) Vegetable powders in which the dose does not exceed five grains.

With these adhesive excipients are indicated, such as syrup, mucilage, glycerite, tragacanth and glucose. The last mentioned answers the requirements better than most other substances. Extracts of gentian, glycyrrhiza and taraxacum are also used.

(2) The officinal masses, extracts and abstracts.

Masses and extracts, being of pilular consistence, require no addition, except when hard, water is incorporated to restore them to their original form. Abstracts and powdered extract of colocynth comp. are best made into a mass with water.

(3) Salts not too deliquescent, and alkaloids.

Excipients for these must combine adhesive and absorbent qualities. They are first triturated with a dry powder, *i. e.*, glycyrrhiza or milk sugar, and then mixed with the adhesive substance, viz: glucose or glycerite of tragacanth.

(4) Volatile oils and oleoresins.

The quantity of these when dispensed in pills being comparatively large, it is necessary to add some light absorbent substance, such as magnesia or starch, to which is added the adhesive material. The practice of adding fused wax to oils is not to be recommended, as the wax tends to render the pill insoluble.

(5) Resins and gum-resins.

These form an adhesive mass by the addition of a little alcohol, with which more bulky excipients, such as soap, may then be incorporated to preserve the shape of the pill.

(6) Salts of the cinchona alkaloids, quinine, cinchonidine and chinoidine.

The former are often prescribed in pill-form in large doses, and it is therefore desirable to reduce their bulk. For this purpose dilute acid (sulphuric) is added in small quantity, which acts dissolving upon the salt, thereby converting it into a mass. This mass soon loses its plasticity, however, and must therefore be rolled into pills as soon as it is formed. Chinoidine acts the same way, although its bulk is not reduced.

(7) Substances easily decomposed by organic matter.

Potassium permanganate is quickly "reduced" when incorporated with the excipients usually employed. Compounds of this character should be mixed with some inert mineral substance and made into a mass with water or petrolatum.

In pills coated with sugar or gelatin, such excipient is frequently employed as will prevent the mass from acting upon the coating—staining the pill. The more soluble a pill the greater is the danger of discoloration of the coating, and although solubility should be the greatest desideratum, it is frequently sacrificed in coated pills for an elegant exterior. With some masses, staining of the coated pill cannot be avoided, no matter what excipient may be employed, in that case some insoluble substance, such as French chalk or starch, is spread upon the pills before the coating is applied.

In *making* pills the following points are to be observed:

The substance, if a solid, must be reduced to a very fine powder, thoroughly mixed with a small quantity of the diluent or excipient; the remainder of the excipient is then incorporated.

The mass must be worked until it is perfectly homogeneous and of such consistence that it will scarcely adhere to the sides of the mortar, but form a coherent mass upon the pestle. A good pill mass is recognized by this quality, in which case the mortar employed will present an almost clean appearance when the mass is finished.

The mortar used for making pills should be a No. 2 or No. 3, with a bottom rather deep than flat; the pestle should not fit too closely, but its extreme end should be shaped somewhat differently from the shape of the bottom of the mortar.

In rolling out the mass the cylinder must be of uniform diameter and even at the ends. When cut upon a pill machine, the cutter is placed lightly upon the cylindrical roll and moved to and fro with gradually increasing pressure, until the roll is divided and the pills formed. These are then rounded with a slab or lid from a wooden ointment box or some similar device, termed a *muller.*

Dusting powder is used for rolling the mass (to prevent it from sticking, for which powd. glycyrrhiza is the best); also for dusting upon the pills to keep them separated from each other and to retain their shape; for this purpose lycopodium answers admirably.

The following pills are officinal (the column of figures showing grains of active drug in each pill):

Pilula—

Aloes (Soap 2 gr.)		2
Aloes et asafœtidæ, of each		1½
Aloes et ferri, of each		1
Aloes et mastiches	aloes	2
	mastich	½
	red rose	½
Aloes et myrrhæ	aloes	2
	myrrhæ	1
Antimonii comp	antimon. sulph.	½
	calomel	½
	guaiac	1
Asafœtidæ	(soap 1 gr.)	3
Cathartic comp	ext. coloc. comp.	1.3
	abstract jalap	1
	calomel	1
	gamboge	¼
Ferri comp	myrrh	1½
	iron carb	1
Ferri iodidi	(ferrous iodide)	1
Galbani comp	galbanum	1½
	myrrh	1½
	asafœtida	½
Opii	(soap ¼ gr.)	1
Phosphori		0.01
Rhei	(soap 1 gr.)	3
Rhei comp	rhubarb	2
	aloes	1½
	myrrh	1
	oil peppermint	0.1

About five hundred different kinds of pills are in general use, mostly prescriptions of professors in medical colleges; to these we deem it unnecessary to refer.

Ointments.

Preparations for External Medication.

To this class belong Ointments, Cerates, Suppositories and Plasters. The vehicle, sometimes called base, of the three first mentioned consists of fatty substances, which permit the easy absorption of the medicinal ingredients.

OINTMENTS.

Ointments are soft, unctuous solids, having a low melting point (from 95°to 105° F).

The *vehicles* used are: lard and benzoated lard; ointment, (simple); lard and wax or spermaceti in different proportions; lard oil, olive oil and suet. Petrolatum and wool-fat are employed in unofficinal ointments.

The medicinal ingredients must be minutely distributed through the vehicle in order that the ointment may not prove irritating and that the greatest possible surface be presented to the epidermis with a view to quick and uniform absorption. For this reason the highest quality of an ointment (next to its proper melting point) is smoothness.

In the preparations of ointments care must therefore be taken that the method employed be such as to yield *smooth* products.

The melting point is governed by the fusibility of the vehicle used, which is either officially directed, as in officinal preparations, or in extemporaneous preparations prescribed by the physicians.

Ointments are *prepared*: (1) by mechanical *admixture*, (2) by *fusion*, or (3) by *chemical reaction*.

(1) Mixing the medicinal substances with the fatty body in a mortar, or on a slab, is the process usually employed for solid substances, especially when insoluble in the fat. Powdered drugs, acids, alkaloids, extracts and salts (not attended by chemical union) are examples adapted to this process.

The following points must be observed:

The *solid* must be in a very fine powder; a small portion of the fat must first be intimately mixed with the powder and the remainder of the vehicle then thoroughly incorporated until a perfectly homogeneous mixture is obtained.

Extracts, especially when hard, are softened by the addition of a small quantity of water, alcohol or glycerin, according to the solvent used in their extraction; then mixed with a small portion of the fat, and finally incorporated with the whole quantity.

Acids, such as boric, carbolic, gallic, tannic, etc., are readily incorporated; a more intimate mixture, however, is obtained when the fat is fused previous to admixture with the drug, but the product then requires to be stirred diligently until cold.

In the preparation of ointments of heavy, dry powders, it is difficult to prevent the agglomeration of the insoluble substance. The method usually followed is to triturate the powder into a cream with a small quantity of olive oil, then add the vehicle; glycerin should never be used for this purpose since it is incompatible with fats. The best method is to triturate the powder with a small quantity of the fat previously melted in a warm mortar, as, for example, in preparing ointment of oxide of zinc.

Officinal ointments prepared by simple admixture, are the following:

Unguentum—	Base.	Parts of drug in 100
Acidi carbolici	ointment	10
Acidi gallici	benz.lard	10
Acidi tannici	"	10
Belladonnæ	"	10
Chrysarobini (chrysophanic acid)	"	10
Gallæ	"	10
Hydrargyri (50 %merc.)	mercury 45; lard 22.5; suet 22.5; tr.benz.comp. 4; mercurial oint. 10	
Hydrargyri ammoniati	benz. lard	10
Hydrargyri oxidi flavi	ointment	10
Hydrargyri oxidi rubri	"	10
Iodi (patass. iod. 1, water 2 parts)	benz.lard	4
Iodoformi	"	10
Plumbi carbonatis	"	10
Plumbi iodidi	"	10
Potassii iodidi (sod.hyposulph. 1)	"	12
Stramonii	"	10
Sulphuris	"	30
Sulphuris alkal. (potass. carb. 10)	"	20
Veratrinæ (alcohol 6)	"	4
Zinci oxidi	"	20

(2) Substances readily fusible by the temperature attained by means of a water-bath should be melted, when prepared in the form of ointments, so that they may be more intimately mixed. [See Lecture II].

The substance having the highest melting point, *i. e.*, resin or wax, is first melted; the fat is then added; when complete liquefaction is effected, the mixture is strained and then stirred until cold.

The following are officinal:

	In 100 parts.
Unguentum: lard	80
Unguentum: wax	20
Aquæ rosæ: oil almonds, exp.	50
Aquæ rosæ: spermaceti	10
Aquæ rosæ: white wax	10
Aquæ rosæ: rose water	30
Diachylon: lead plaster	60
Diachylon: olive oil	39
Diachylon: oil lavender	1
Mezerei: fl. ext. mezereum	25
Mezerei: lard	80
Mezerei: wax	12
Picis liquidæ: tar	50
Picis liquidæ: suet	50

(3) By *chemical reaction*, whereby the character of the medicinal substance, and also that of the vehicle, is changed.

The only ointment of this class officinal is that of mercuric nitrate, in which the mercury is acted upon by nitric acid, forming mercuric nitrate and the excess of acid employed also oxidizes the fat (lard), a new compound being formed, termed *elaidine*.

Unguentum—	In 100 parts.
Hydrargyri nitratis (Citrin ointment): mercury	7
Hydrargyri nitratis (Citrin ointment): acid nitric	17
Hydrargyri nitratis (Citrin ointment): lard oil	76

For details of process see U. S. P. or the Dispensatory.

COLLODIONS.

Collodium, a preparation described later, is employed as a vehicle for a class of preparations used in external medication termed Collodions—*Collodia* U. S. The following are officinal:

	In 100 parts.
Collodium flexile: Canada turpentine	5
Collodium flexile: castor oil	3
" c. Cantharide: cantharides	60
" c. Cantharide: in flexible collod.	
" Stypticum: ac. tannic	20
" Stypticum: alcohol	5
" Stypticum: stronger ether	20

Cerates.—Suppositories.—Plasters.

CERATES.

Cerates are mixtures of fats similar to the ointments, but of firmer consistence, because they contain wax (or other substances having a higher melting point than lard) in greater proportion than do ointments. In the preparation of cerates the same rules are to be observed as noted under ointments.

The officinal cerates are divided into two classes:

(1) Prepared by fusion or simple admixture:

		IN 100 PARTS.
Ceratum	white wax	30
	lard	70
Camphoræ	camphor linim.	3
	olive oil	12
	cerate	85
Cetacei	spermaceti	10
	white wax	35
	olive oil	55
Plumbi subacetatis	sol. lead subacetate	20
	camphor cerate	80
Resinæ	resin	35
	wax	15
	lard	50
Sabinæ	fl. ext. sabine	25
	resin cerate	90

(2) By maceration in connection with fusion:

Ceratum		IN 100 PARTS.
Cantharidis	cantharides	35
	wax	20
	resin	20
	lard	25
Extracti Cantharidis	cantharides	30
	resin	15
	wax	35
	lard	35
	alcohol	

In *cantharides cerate* the cantharides in fine powder is digested for half an hour in the melted fats so that the vesicating principle may be dissolved and the cerate therefore be more active. It must however, not be *strained*, but carefully stirred until cool.

SUPPOSITORIES.

Suppositor es may be defined as cone-shaped masses of medicated fats, possessing a consistence insuring their quick fusion when introduced in the body.

The vehicle is cacao butter (oleum theobromæ), which possesses the property of melting at the temperature of the human body (95° F.), and yet remaining firm at ordinary temperatures. An addition of 10 per cent. of spermaceti has been recommended to give more stability.

The methods of preparing suppositories are quite numerous, and any process may be considered good by which the product is obtained uniform in size and shape and with the medicinal ingredients thoroughly incorporated. Moulds are usually employed; the medicinal ingredients, if solid, are first reduced to powder in a mortar, and mixed with a small quantity of the oil, this mixture is then added to the remainder of the oil previously melted and cooled to 95° F. The whole is then thoroughly mixed, and if possible, without further heating, poured in the moulds previously chilled.

Another process consists in rolling the mass on a slab, cutting it as in making pills, and forming the cones with the fingers. Moulds prepared from paper, plaster paris, etc., are also used; compression of a mixture of the ingredients in a coarse powder has also been recommended, etc.

No formulas for suppositories are officinal in the U. S. P. '80; the process only is given; it is directed, however, that, unless otherwise specified, the weight of a suppository shall be 1 gram (15 grains).

PLASTERS.

Plasters are compounds of various solids of such high melting point as to be friable when cold, but rendered adhesive by the warmth of the body.

The *vehicles* of plasters are: lead plaster; resinous substances, made adhesive by admixture with the medicinal ingredient, and simple plasters, such as isinglass.

The *making* of plasters does not differ materially from the process employed for ointments and cerates, since they are all prepared by melting the various substances by means of a water bath, and adding the medicinal substances last. Care must be taken, however, that the heat be not continued too long, lest the product be impaired.

The *spreading* of plasters, though usually done on a large scale, may be easily effected by the pharmacist with the use of a plaster iron. [For apparatus and details of process, see Remington's or Parrish's Pharmacy and U. S. Disp.]

The officinal plasters may be divided into:

(1) Simple plasters

Emplastrum—

Ammoniaci (prepared with dil. acetic acid)

Ichthyocollæ (court plaster)

[For formulæ see U. S. P.].

		IN 100 PARTS.
Picis Burgundicæ	Burgundy pitch	90
	wax	10
Picis Canadensis	Canada pitch	90
	wax	10
Plumbi	lead oxide	32
	olive oil	60
	water sufficient.	

For the last-named process, showing the formation of *glycerin*, see the Dispensatory.

(2) Compound plasters

Emplastrum—

		IN 100 PARTS.
Ammoniaci cum hydrargyro	ammoniac	72
	mercury	18
	olive oil	0.8
	sulphur	0.1
	dil. acetic acid	
	lead plaster	
Arnicæ	extract arnica root	33.3
	resin plaster	66.66
Asafœtidæ	asafœtida	35
	lead plaster	35
	galbanum	15
	wax	15
	alcohol	
Belladonnæ	ext. belladonna root	10
	resin plaster	90
Capsici	oleoresin capsicum	
	resin plaster	
Ferri	hydrated iron oxide	10
	Canada turpentine	10
	Burgundy pitch	10
	lead plaster	70
Galbani	galbanum	16
	turpentine	2
	Burgundy pitch	6
	lead plaster	76
Hydrargyri	mercury	30
	olive oil	10
	resin	10
	lead plaster	50
Opii	extract opium	6
	Burgundy pitch	18
	lead plaster	76
	water	
Picis cum cantharide	cerate cantharides	8
	Burgundy pitch	92
Resinæ	resin	14
	wax	6
	lead plaster	80
Saponis	soap	10
	lead plaster	90

Questions on Lecture III.—Series 7.

☞In answering write your Name, *full* Address and your *Class Page* at the top of page, also the number of Lecture and the Date of sending the answers.

1. What is the difference between "dissolving" and "melting"?
2. To what is the phenomenon of complex Solution *due*?
3. What causes the phenomenon of cold as exhibited by "freezing mixtures"?
4. What conditions favor *simple* solution?
5. What is the difference between a *saturated* and a *supersaturated* Solution?
6. How does a Solution and a Solvent differ with reference respectively to *density* and *boiling point*?
7. What is the *official* title of Solutions as a class? What *solvent* is employed in preparing the Officinal solutions?
8. Are all *sparingly* soluble Substances *slowly* soluble? Name an exception.
9. What is the cause of Diffusion and Osmosis?
10. State the difference between Osmosis and Dialysis?
11. Define Precipitation.
12. Mention the different methods by which Crystals may be formed.
13. What is the difference between Elutriation and Levigation?
14. Define Filtration.
15. What do you understand by Subsidence and Decantation?
16. What filtering media are in common use?
17. How is Decoloration usually effected?
18. Why is Coffee *clarified* by Egg-white?
19. What is the distinction between Straining and Filtration?
20. What *forces* are utilized in the process of Percolation?
21. What determines the *exhaustion* of a drug in Percolation?
22. What points must be observed to conduct Percolation successfully?
23. Why are some drugs *macerated* before they are percolated?
24. When are drugs to be used in *coarse* powder and when in *fine* powder?
25. What *properties* should characterize a Menstruum? Define the term "Marc."

IMPORTANT.

Students will please reply to the above questions on *letter-size* paper (about the size of this sheet), *in ink*, as briefly as possible and without copying the lecture. Write plainly, on *one* side of the paper only (which must be signed or no notice will be taken of it), and forward promptly to the director. Write the number of the question in each margin in *Arabic* figures. Write a copy of your answers and preserve it for future reference.

NOTE ON LECTURE IV.

Each particular form of preparation should be carefully studied, by additional reference to the U. S. P. or Dispensatory when required, and the tables showing the *number* of preparations and their *strengths* as far as possible memorized.

The Director.

National Institute of Pharmacy.

LECTURES, SEMI-MONTHLY, BY MAIL.
C. S. HALLBERG, Ph. G., *Director.*

DEPARTMENT OF EXAMINATIONS.

CHICAGO, Aug, 1891.

O. F. Carpenter, East Hampton, Conn.

Upon Questions on Lecture IV, Series 7, we transmit the following printed answers for further comparison and study:

1. A Pharmaceutical preparation is such a one as is commonly made by the pharmacist, its manufacture involving no chemical processes; a Pharmacopœial is one recognized by the pharmacopœia.

2. Distribute 2 parts of Volatile Oil through 4 parts of purified Cotton and percolate with Distilled Water to make 1000 parts of product.

3. Waters are aqueous solutions of volatile substances. Liquors of non-volatile substances.

4. No difference in *strength.*

5. Mucilages are prepared by dissolving or macerating the solid substance in water and straining.

6. Not less than 10 nor more than 12 per cent of alcohol.

7. ———

8. Liniments are a varying class of liquid preparations intended for external application and usually possessing an oleaginous base; Oleates (officinal) are liquid or semi-liquid solutions in oleic acid, also for external medication.

9. (a) 65. (b) Gentian, 8, bitter orange, 4, and cardamom, 2. (c) 40.

10. Maceration, percolation, solution and admixture.

11. Elixir Aurantii.

12. Fluid Extract, Extract, Abstract and Resin.

13. In the Syrup, the drug is extracted by maceration with alkaline water; in the Fluid Extract by percolation with a hydroalcoholic menstruum.

14. An aqueous menstruum.

15. Ammoniac, Almond and Asafetida.

16. Iodine, Tolu, Ferric Acetate, Ferric Chloride and Green Soap.

17. Mel Despumatum is prepared by heating and straining ordinary honey.

18. They are more constant and uniform.

19. ———

20. ———

21. Dilute Alcohol, U. S., contains 47 per cent of absolute alcohol by volume. 12 fluid ounces of 65 per cent alcohol will yield as many fluid ounces of Dilute Alcohol as 47 is contained in the product of 12 and 65.

$$\frac{65 \times 12}{47} = \frac{780}{47} = 16\frac{28}{47} \text{ fluid ounces.}$$

22. (a) Glycerite of tragacanth.
(b) Soap and a few drops of dilute Alcohol.

23. Incorporate the Extract and Acid with 7 drachms of the Lard, each separately; then mix them.

24. Mix the extract of opium and the tannin each with ½ ounce of the oil of theobroma separately; then mix them, preferably without melting, in a mortar, roll out and cut upon a pill tile, and form with the fingers while plastic.

In the last two examples the ingredients are thus incorporated in order to prevent the formation of the insoluble tannate of the alkaloids, as far as possible, and to prevent the agglutination of the medicinal ingredients.

25. (a) Lead plaster. (b) Refer to U. S. P., or a dispensatory.

26. Glycerin.

Your rating on answers to Lecture 4 *is* 90 *per cent.*

The abbreviations "P.," "Col." and Par.," are used to indicate "page," "column," and "paragraph," respectively.

In rating the answers, your *general understanding of the subjects* and the *appearance of your paper*, are also taken into consideration.

☞ The above questions should be *carefully reviewed* upon receipt of corrections. If questions to any other Lectures remain unanswered, please send them in at once.

THE DIRECTOR.

Always continue to answer in the regular order without waiting for delayed observations. Corrections are always forwarded as promptly as possible.

☞ NOTICE.—Do not fail to write your name, full address and CLASS page 627, at the TOP of the first page of your answers.
In all correspondence the CLASS page must be stated in order to insure prompt attention.

The Organic Acids.

The Organic Acids, like the inorganic acids, are built on the type of the water-molecule, and like them also, they may be monobasic, dibasic, tri-basic, etc., according as they have one, two, three or more replacable hydrogen atoms.

An organic acid differs structurally from an *inorganic acid*, in having one of the Hydrogen atoms of the water-molecule replaced by an *organic* compound radical, instead of an *inorganic* radical.

Their structural resemblances and differences are shown by the following examples :

$H-O-(NO_2)$=Nitric acid, a monobasic inorganic acid.

$\left.\begin{matrix} H-O \\ H-O \end{matrix}\right\rangle (SO_2)$=Sulphuric acid, a dibasic inorganic.

$H-O(COH)$=Formic acid, a monobasic organic acid.

$\left.\begin{matrix} H-O \\ H-O \end{matrix}\right\rangle C_4H_4O_4$=Tartaric acid, a dibasic organic acid.

The organic resemble the inorganic acids also in their general properties, and like them form salts with the metals. As a whole, however, they are less stable, and their instability as a rule increases with the complexity of their molecules.

Just as there are series of the alcohols, there are also series of acids, the different members of the series bearing definite relations to each other. The lower terms of the series, that is, those with the least complex molecules, are usually *liquid*, and their density and the temperature of their boiling point *increase* with the complexity of their molecular structure, the higher terms in the series being usually solids at ordinary temperatures.

For example :

Formic acid, $H(CO_2H)$, a liquid, boils at 212° F.
Valeric acid, $H(C_5H_9O_2)$, a liquid, boils at 367° F.
Stearic acid, $H(C_{18}H_{35}O_2)$ a solid, melts at 156° F.

The organic acids are very numerous, and are derived both from the vegetable and animal kingdoms.

Only those will be described here that are of importance in pharmacy. These acids are :

Acetic, Carbolic, Gallic, Oleic Salicylic, and Benzoic, Citric, Lactic, Oxalic, Tannic, Tartaric.

ACETIC ACID—$C_2H_4O_2$—*monatomic*,

that is, it has one replacable hydrogen atom.

SOURCES AND PREPARATION.

Acetic acid may be obtained from dilute alcoholic solutions, by the oxidation of the alcohol, or from the acetates, by the substitution of stronger acid.

Its chief source is from the dry distillation of wood in iron retorts. These are heated to a high temperature, and the products conducted through a cooled coil, to a receiver, where a part is conducted, and another part, consisting of uncondensable gases, acetylene, ethylene, marsh-gas, carbon monoxide, etc., are conducted off and utilized for fuel, while charcoal remains in the retort. The product accumulated in the receiver soon separates into two layers : the lower consisting of tarry matters containing creasote, oils, various hydro-carbons, etc., and the upper consisting of an aqueous solution of acetic acid, methyl alcohol, acetone, and various other matters. This is called *crude* wood vinegar.

To obtain the acetic acid purified, the latter liquid is drawn off, and the methyl alcohol and acetone separated by fractional distillation. That which remains after distilling off about 10% is called *purified* wood vinegar.

This remaining liquid is treated with an excess of milk of lime, acetate of lime is formed, and at the same time various insoluble compounds of lime with the tarry impurities present. After settling, the clear liquid is drawn off, and treated with sodium sulphate ; in the double decomposition which takes place, insoluble calcium sulphate and soluble sodium acetate are formed. The clear liquid containing the sodium acetate is now drawn off, evaporated to dryness, heated to about 500° F., to char any remaining organic impurities, and then dissolved in water, and the clear liquid separated from the sediment. The solution, if the process has been properly conducted, should contain nearly pure sodium acetate. The acetic acid is separated by treating the liquid with sulphuric acid, which combines with the sodium, setting the acetic acid free. After standing for a time, the clear liquid is drawn off from the crystals of sodium sulphate that have been formed, and distilled. The product is acetic acid, containing a considerable per centage of water. Much of the water can be gotten rid of by fractional distillation, but not all, as acetic acid is strongly hygroscopic.

The *oxidation method* for obtaining acetic acid is well illustrated in what is called the "quick vinegar process." A dilute alcoholic solution (5 to 7%) is permitted to drip slowly through a large cask filled with clean wood shavings. The cask is perforated with holes for free circulation of air. Before adding the dilute alcohol, a small quantity of warm vinegar is poured in, and some fermented malt liquor, or some "mother of vinegar." The latter contains microscopic plants (*mycodermi aceti*), which act as a ferment. The alcoholic solution is now permitted slowly to drip through the cask ; soon the shavings become coated with the ferment organisms, oxidation of the alcohol takes place, the temperature of the interior of the cask rises, causing a free circulation of air, and the alcoholic solution is now rapidly converted into a more or less impure solution of acetic acid, which issues in a slow stream from an orifice in the bottom of the cask, and is called vinegar.

Vinegars are also made by fermentation of the poorer qualities of wine (wine vinegar), of cider (cider vinegar), of malt (malt vinegar), etc. In all these processes, alcohol is first produced by the fermentation of a saccharine solution, and then the alcohol, by agency of the *Mycodermi aceti* and exposure of the liquid to the air, is oxidized to acetic acid. Pure acetic acid may be obtained from vinegar by a process similar to that which has been described for obtaining it from wood vinegar.

Absolute Acetic Acid is a colorless liquid, with a strongly acid taste and reaction, and a pungent acid odor. It mixes in all proportions with water and alcohol, solidifies in crystals at a temperature of 62° F., and boils at 214.5° F.

Its degree of concentration cannot readily be determined by its specific gravity, as that varies irregularly with the temperature, as well as with the amount of absolute acetic acid in the solution.

Three strengths of acetic acid are official :

Acidum Aceticum contains 36 per cent. acid (64 per cent. water.

Acidum Aceticum Dilutum ; acetic acid U. S. 17 parts, water 83 parts ; contains 6 per cent. absolute acetic acid. It has replaced vinegar in the officinal Vinegars, owing to its greater purity and uniformity in strength.

Acidum Aceticum Glaciale is prepared by distilling anhydrous acetate of sodium with strong sulphuric acid.

Officinal acetates and preparations of acetates are : Plumbi Acetas, Potassii Acetas, Sodii Acetas. Zinci Acetas, Morphinæ Acetas, and Amonii Acetas (liquor).

Organic Acids—(Continued).

BENZOIC ACID—$C_7H_6O_2$—*monobasic*,

obtained by sublimation from Benzoin (see Lecture II., page 20), a gum-resin.

Only from 7 to 8% of acid is obtained by this process, the remainder of the acid, nearly an equal amount, being left in the benzoin. This may be obtained by powdering it, treating it with one-fourth its weight of lime, and ten or twelve times its weight of water, filtering while hot, concentrating and supersaturating with chlorhydric acid. The crystalline precipitate thus obtained is not pure benzoic acid, but it may be freed from resin and coloring matter by redissolving it in about 20 times its weight of boiling water, adding some animal charcoal, filtering and recrystallizing.

Benzoic acid may also be prepared from certain coal-tar products, and it is made in Germany by treating hippuric acid with chlorhydric acid.

Character.—Soluble in 500 parts of water at 59° F., in 15 parts of boiling water, and far more soluble in alcohol than in water; completely volatilized without change when heated on platinum foil; heated with 3 parts of quicklime in a test tube, it evolves the odor of benzol.

Uses.—In medicine chiefly in genito-urinary diseases in the dose from 5 to 10 grains; also as an antiseptic in surgery.

Officinal preparations.—Ammonii Benzoas; Lithii Benzoas; Sodii Benzoas; Tinctura Opii Camphorata; Adeps Benzoinatus.

CARBOLIC ACID,—C_6H_6O,—OR PHENOL,

a coal-tar product obtained by distilling that portion of coal-tar known as "dead oil," and collecting what comes over between the temperatures of 302° and 392° F. This, after two rectifications, between the temperatures of 338° and 374° F., constitutes the crude carbolic acid of the U. S. P.

The steps in making the pure acid from the crude product may be summarized as follows: Treat with caustic potassa, drain the crystals of carbolate of potassa thus obtained, heat them to about 338° F., to destroy certain adhering empyreumatic matters, dissolve in water to separate oily matters, supersaturate the aqueous solution with chlorhydric acid, agitate repeatedly the oily liquid which separates with a solution of common salt, then digest it with chloride of calcium to remove the water, and distil it, collecting only that which distils over between the temperatures of 336° and 374° F. On exposing this to the temperature of freezing water, the carbolic acid will crystallize out in a nearly pure form, and the mother liquor may be drained off.

Character.—Carbolic acid not strictly an acid, but an alcohol termed Phenol, resembles creasote in its odor, in its caustic properties, in its antiseptic power, and in many of its uses, but differs from it in chemical composition (the formula for creasote being $C_8H_{10}O_2$), in being a solid at ordinary temperatures, in having a lower boiling-point, in having a higher specific gravity, in its power to coagulate collodion when mixed with it, and in its far greater solubility in water.

Carbolic acid will remain permanently fluid if the crystals be melted by immersing the containing bottle in hot water, and then mixing water with the liquified crystals in the proportion of one part of the former to nineteen of the latter. By using alcohol, instead of water, solution may be effected without the use of heat by simply placing the containing vessel "upside down."

Uses.—The most important uses of carbolic acid are as a disinfectant and antiseptic.

As a dressing, carbolic acid is usually applied in the form of carbolated oil, or petrolatum.

The *lotion* is prepared by dissolving one part of carbolic acid in thirty of hot water.

For internal administration, only the purest kinds should be dispensed. The dose is about one grain, largely diluted.

Officinal Preparations.—Acidum Carbolicum, sp. gr. 1.065, the pure form described above.

Acidum Carbolicum Crudum, containing carbone and chresylic acids in variable proportions, together with other substances and,

Unguentum Acidi Carbolici.

CITRIC ACID—$C_6H_8O_7+H_2O$—*tribasic*,

one of the series of fruit acids, and obtained chiefly from lemons and limes.

The expressed juice is first clarified by boiling, and the clear liquid treated with carbonate of lime. From the calcium citrate thus formed the citric acid is liberated by treating it with sulphuric acid, and afterwards repeatedly crystallizing.

Character.—Citric acid crystallizes in right-rhombic prisms, of an agreeably acid taste, soluble in ¾ of a part of cold water and ½ a part of boiling water; if an aqueous solution of it be added to lime-water it remains clear until boiled, when a white precipitate falls, which will nearly all be taken up when the liquid cools. [For tests of purity see U. S. P.]

As the compounds of iron and citric acid readily decompose at a high temperature, the Pharmacopœia directs that in drying them the temperature be not raised above 140° F.

Officinal Preparations.—Bismuthi Citras; Lithii Citras; Potassii Citras; Liquor Ferri Citratis; Liquor Magnesii Citratis; Liquor Potassii Citratis; Syrupus Acidi Citrici.

Some of these enter into the following preparations: Bismuthi et Ammonii Citras; Ferri Citras: Ferri et Ammonii Citras; Ferri et Quininæ Citras and Ferri et Strychninæ Citras.

GALLIC ACID—$C_7H_6O_5+H_2O$—*monobasic*,

found in uva-ursi, sumach, in some other astringent plants, and in nut-galls, which is its principal source. It is obtained by exposing powdered galls to the action of the air for a considerable time in a warm, moist place.

During this process the tannic acid of the galls being a glucoside is slowly changed into gallic acid through the fermentation which sets in at a slightly elevated temperature. The latter is extracted from the pasty mass by means of hot water, which deposits crystals of the acid on cooling. Care must be observed not to bring the crystals in contact with iron during the process, otherwise discoloration will take place.

Character.—Gallic acid thus obtained is in the form of whitish or fawn-colored silky needles, which are without odor and have a slightly astringent taste, soluble in 100 parts of cold and three parts of boiling water; at 59° F. soluble in 2.6 parts of absolute alcohol.

It differs from tannic acid *in not being precipitated by a solution of gelatin*, except in the presence of gum. For tests of purity see U. S. P.

The only officinal preparation is: Unguentum Acidi Gallici.

Organic Acids—(Continued).

TANNIC ACID—$C_{14}H_{10}O_9$—*tribasic.*

There are many varieties of this acid, all agreeing in producing *dark-colored precipitates with salts of iron*, and in *precipitating gelatin* from its solution, but differing in minor particulars.

The variety called *gallo-tannic acid*, which is obtained from officinal galls that are found in the cupules of some oaks, the leaves of Rhus coriaria, and in some other plants, differs from the rest in being convertible, as explained above, into gallic acid.

Preparation.—Tannic acid is extracted from galls by means of water and ether, and the solvents expelled by exposing the extract to a temperature a little below the boiling point of water until changed into a dry, porous mass.

Character.—Light yellowish scales that have a strongly astringent taste and an acid reaction; soluble in 6 parts of water at 59° F. and in .6 parts of alcohol at the same temperature, very soluble in both liquids at the boiling temperature, and soluble in 6 parts of glycerin, completely volatilized when heated on platinum foil.

In mixing preparations containing tannic acid (tannin), except in the dry powdered form, iron spatulas, or other implements of this metal, should not be used less the product becomes blackened.

Officinal Preparations.—Collodium Stypticum; Trochisci Acidi Tannic; Unguentum Acidi Tannic. (U. S. P. '70. Glyceritum Acidi Tannici.)

LACTIC ACID—$C_3H_6O_3$—*monobasic,*

formed in milk when it sours by the fermentation of the sugar of milk, and may be formed in solutions of various other sugars by fermentation in the presence of casein and certain other proteid compounds resembling it. Several different varieties of lactic acid are known which differ from each other in minor characteristics.

Preparation.—There are various methods of obtaining it; one of the simplest is to mix 25 parts of milk sugar, 20 parts of chalk, 100 of skimmed milk, and 200 of water, and digest at a temperature of about 75° F. for six weeks until the chalk has passed into solution. The temperature is now elevated to a little below the boiling point, the cheese skimmed off, the liquid clarified by means of albumen, and concentrated, to crystallize the lactate of calcium. The crystals thus obtained are purified by recrystallization, and the lactic acid set free by treating them with just a sufficient quantity of sulphuric acid.

Acidum Lacticum U. S. contains 75 per cent. of absolute acid, to 25 per cent. of water.

Character.—A syrupy liquid sp. gr. 1.212, miscible in all proportions with water, alcohol and ether, but not with benzin or chloroform.

Officinal Preparations.—Ferri Lactas; Syrupus Calcis Lactophosphatis.

Syrup of Calcium Lactophosphate, when prepared according to the U. S. P., is prone to form a gelatinous precipitate, owing probably to the inability of the lactic acid to hold the lime in solution in the presence of sugar. This may be avoided by the addition of 5 per cent. of the strong acid to the finished syrup. Precipitation is also prevented by the use of an excess of hydrochloric acid, but such substitution is not admissible.

OLEIC ACID—$C_{18}H_{34}O_2$—*monobasic,*

one of the series of fatty acids contained in most of the non-drying oils.

Obtained as a by-product in the manufacture of stearine candles. Also by saponifying almond oil with oxide of lead, dissolving the lead oleate in benzin, decomposing the oleate with chlorhydric acid, evaporating the benzin and washing the oleic acid with water.

Character.—When pure, a colorless, inodorous, and tasteless liquid sp. gr. .900 to .910; insoluble in water and freely soluble in alcohol and ether. As it undergoes slow oxidation and becomes rancid on exposure to air, it should be kept in tightly stoppered bottles.

The solution of oleic acid, if pure, should be perfectly clear and homogeneous at a temperature of 77° F., and reduced to a temperature of 45° F., should not deposit crystals of stearic or palmitic acid.

It is used in pharmacy in preparing oleates, being more cleanly to use than the oils, is less irritant, and more readily absorbed by the skin.

Officinal Preparations. — Oleatum Hydrargyri; Oleatum Veratrinæ.

OXALIC ACID—$H_2C_2O_4+2H_2O$—*dibasic.*

Widely distributed in the vegetable kingdom, occurring as acid potassium oxalate in sorrel and some other plants, but more commonly in combination with calcium. This latter compound is also found in the animal body.

It may be prepared by heating in a retort 1 part of sugar with 8 parts of nitric acid (sp. gr. 1.38) until red nitrous fumes cease to be given off, then concentrating to one-sixth its first volume and crystallizing. After pouring off the mother liquor, the crystals are redissolved in hot water and purified by recrystallization.

Character.—Soluble in 8 parts of cold water and in all proportions in boiling water. The pure acid does not blacken when heated on platinum foil, but melts at about 208° F. and sublimes at about 320° F., being partly decomposed into carbon monoxide and carbon di-oxide. The crystals are colorless, intensely sour to the taste, and poisonous. The proper antidote is chalk or magnesia.

Officinal Prep.—Cerii Oxalas; Ferri Oxalas.

Oxalic acid itself is not officinal, but represented in the Volumetric Solution for quantitative testing. (See U. S. P. or Disp.)

SALICYLIC ACID—$C_7H_6O_3$—*monobasic,*

occurring in combination to some extent in the vegetable kingdom.

It is prepared on a large scale from carbolic acid by a rather complicated process; but it may be obtained for experimental purposes by heating oil of wintergreen with a strong solution of caustic potassa so long as methylic alcohol is given off, and treating the potassium salicylate thus formed with chlorhydric acid, which combines with the potassium, setting the salicylic acid free.

Organic Acids.—The Alcohols.

SALICYLIC ACID—(Continued).

Character.—Colorless, needle-shaped crystals, acid and slightly acrid to the taste; melting at 312° F., sublimes unaltered if carefully heated to 392° F., but if rapidly heated to about 440° it is decomposed, partly at least, into carbon dioxide and carbolic acid.

Salicylic acid should be free from the odor of carbolic acid; its aqueous solution acidified with nitric acid should yield no precipitate with silver nitrate (absence of chlorhydric acid) and no precipitate with barium chloride (absence of sulphuric acid); heated on platinum foil it should leave no residue of mineral impurities, and its solution in cold sulphuric acid should be colorless, or have only a slightly yellow color, showing the absence of organic impurities.

Uses.—Salicylic acid and its compounds, particularly the salicylate of sodium, are extensively used and of great value in acute articular rheumatism. The acid is also of much value as an antiseptic and preventive of fermentation.

Officinal Preparations.—Lithii Salicylas; Physostigminæ Salicylas; Sodii Salicylas.

TARTARIC ACID—$C_4H_6O_6$—*dibasic*,

found either free or in combination in the juices of many fruits—as grapes, tamarinds, sumach berries, pineapples, etc. Its principal commercial source is from cream of tartar, which in turn is derived from the crude tartar or argol that collects in the form of crystalline crusts on the sides of casks of fermenting wine.

It is obtained from cream of tartar by adding calcium carbonate to its aqueous solution, forming calcium tartrate with the excess of acid in the tartrate, then calcium chloride is added, which decomposes the remainder and forms more calcium tartrate. This is thoroughly washed and decomposed by sulphuric acid, which forms nearly insoluble calcium sulphate and soluble tartaric acid. The clear liquor is decanted and the tartaric acid crystallized.

Character.—Colorless crystals of oblique rhombic prisms, not deliquescent, containing no water of crystallization, inodorous, intensely but agreeably sour, sp. gr. 1.764, soluble in 0.7 parts of water at 59° F., and at the same temperature in 2.5 parts of alcohol, or 3.6 of absolute alcohol, insoluble in chloroform and benzin.

Tartaric acid itself is not much used medicinally; but in the powdered form it is an ingredient in Seidlitz powder; several of its compounds are also officinal.

Antimonii et Potassii Tartras; Ferri et Ammonii Tartras; Ferri et Potassii Tartras; Potassii Bitartras; Potassii et Sodii Tartras.

Other *organic acids* used to some extent in pharmacy but not officinal in the U. S. P., are

Formic acid, is made by heating together glycerin and oxalic acid.

Succinic acid, prepared by the dry distillation of amber.

Valerianic acid, obtained from the root of Valeriana officinalis.

Besides these, a host of other organic acids exist in various organic products that enter into the constitution of our Materia Medica, and are more or less important constituents of various preparations, but are seldom isolated for medicinal use. For description of these see Remington's or Parrish's Pharmacy, or some work on inorganic chemistry.

THE ALCOHOLS AND ETHERS.

The Alcohols constitute a large and important series of compounds. They are all *hydrates of* more or less complex *carbohydrogen radicals*, which may be *mono*, *di*, *tri*, or *poly-basic*, and so give rise to several distinct series of alcohols.

To the monohydrates belong:

Methyl alcohol, or wood spirit.....$(CH_3)HO$,
Ethyl " or spirit of wine, ...$(C_2H_5)HO$,
Propyl " .....$(C_3H_7)HO$,
Butyl " .....$(C_4H_9)HO$,
Amyl " .....$(C_5H_{11})HO$,
and many others.

To the dihydrates belong:

Ordinary glycol .....$(C_2H_4)2HO$,
Propyl " .....$(C_3H_6(2HO$,
Butyl " .....$(C_4H_8)2HO$,
Amyl " .....$(C_5H_{10}2HO$,
and some others.

To the Trihydrates belong the Glycerins, of which several are known; but only one is common and well studied, that is:

Propenyl Alcohol, or common Glycerin $(C_3H_5)3HO$.

From certain lichenes and some other plants is extracted a coloring matter which is called Erythrite, having the formula $(C_4H_6)4HO$, and therefore illustrates a tetrahydrated alcohol.

Mannitol or Mannite has the formula $(C_6H_8)6HO$, and is therefore a hexahydrated alcohol.

All the alcohols are characterized:

(1) By being neutral to test paper.

(2) Decomposable by the action of acids into ethers and water.

(3) Convertible by the withdrawal of a portion of their hydrogen into aldehydes.

From the pharmaceutical point of view, the most important alcohols are: Methyl alcohol, Ethyl alcohol, Amyl alcohol, and Propenyl alcohol, or Glycerin.

METHYL ALCOHOL AND ITS DERIVATIVES.

Methyl alcohol—$(CH_3)HO$, commonly called "wood spirit," is one of the products of the dry distillation of wood, and this is its principal commercial source. The aqueous portion of the distillate contains about one per cent. of it, along with acetic acid and various other compounds.

Preparation.—After neutralizing the acetic acid with lime, the liquid is distilled at a temperature below the point of boiling water, and the product is crude wood spirit; this is further purified by repeating the distillation at a temperature of about 152° F. The product is then treated with calcium chloride to remove the remaining water, and again distilled at the same temperature. The product thus obtained is nearly pure.

Character.—Limpid, colorless, volatile liquid, of a peculiar odor, and a warm alcoholic taste, sp. gr. at 32° F. .814; boiling point 149° F.

Uses.—It is not officinal, and but little used in medicine; but on account of its volatility and its solvent power, it has many important uses in the arts. Methylated spirit, so often alluded to in English works, is common alcohol mixed with 10 per cent. of methyl alcohol.

Ethyl Alcohol and Derivatives.

ETHYL ALCOHOL—(C_2H_6O), OR ALCOHOL.

Obtained from spirituous liquors of various kinds by successive distillations or rectifications.

Alcohol, having a lower boiling point than water, gradually accumulates in the first portion of each distillate. But by distillation alone it cannot be entirely freed from water, and it often also contains a small portion of amyl alcohol or fusel oil, which for many uses it is desirable to get rid of. This is accomplished by percolating the alcohol or spirituous liquor through freshly prepared charcoal, which retains the fusel oil.

Alcohol is anhydrated by treating it with caustic lime and afterward distilling it; the lime having such a strong affinity for water that it withdraws it from the alcohol, and does not again part with it except at a temperature far above the boiling point of alcohol.

Absolute Alcohol is a colorless mobile liquid, with a feeble odor and a caustic taste; its sp. gr. is .794 at 60° F.; its boiling point at 30 inches barometer is 173° F.

It has a very strong affinity for water, and to this its caustic taste is probably due; for this reason also it must be kept in perfectly sound vessels, so that it will not absorb moisture from the air. Potassium permanganate is wholly insoluble in absolute alcohol, and a crystal of it imparts no color to it; but if it contain only .05% of water it becomes tinged by it. Another test for water is to treat a portion of it with perfectly anhydrous sulphate of copper. If water be present, the sulphate will acquire a bluish color

Its most important use in the plarmaceutical laboratory is as a reagent.

Alcohol, U. S., contains 91% by weight of absolute alcohol; 94% by volume; sp. gr. at 60° F. .820.

[For tests of purity see U. S. P.]

Diluted Alcohol.—Alcohol Dilutum, U. S.—A mixture of equal parts by weight of alcohol and water. It therefore contains 45.5% by weight, or 53% by volume, of absolute alcohol; sp. gr. at 60° F. .928.

Uses.—Chiefly as a menstruum for tinctures; by far the larger proportion of all the medicinal principles being soluble in it, and the tinctures thus obtained are reasonably permanent.

Proof Spirit, according to the standard of the U. S. Custom House, consists of equal parts by volume of absolute alcohol and water, having the sp. gr. .936 at 60° F.

According to the same authority, second proof contains 52½% of absolute alcohol, sp. gr. .931; third proof contains 55½% of absolute alcohol, sp. gr. 925; and fourth proof contains 58% of absolute alcohol, sp. gr .920. Spirits that are stronger than these are said to be over proof.

Whiskey.—Spiritus Frumenti, U. S.

Usually obtained by the distillation of a fermented infusion of a mixture of Indian corn and rye.

The fermenting mixture is termed "mash," and the weak spirit obtained by the first distillation is called low wine. This is again rectified, to still further concentrate it and get rid of the fusel oil (most of which comes over with the last portion of the distillate, and is, of course, collected separately), and this product is called raw whiskey. It is allowed to stand in casks or barrels for a period of years, during which it undergoes changes which improve its quality. Whiskey thus mellowed by age is called old whiskey.

The Pharmacopœia requires that whiskey shall be at least two years old, that it shall have an amber color, a sp. gr. not above .930 nor below .917, and that its alcoholic strength shall not be less than 44% nor more than 50%.

Brandy.—Spiritus Vini Gallici, U. S.

Obtained by the distillation of fermented grapes.

Brandy improves with age the same as whiskey, the improvement in each case being chiefly due to the gradual chemical change and disappearance of the traces of fusel oil that could not be separated by fractional distillation. The Pharmacopœia directs that brandy shall be at least four years old. [For tests of purity see U. S. P.]

WINES.

These are produced by the fermentation of fruit juices, chiefly those of the different species of grapes. They may be divided into *white* and *red* wines.

The former are not usually white, but light-colored and are produced by the fermentation of the expressed juice alone, without the pericarp; while the red wines are reddish in color, because the juice has been fermented in contact with the skins, and has consequently taken up more or less of their coloring matter, and therefore contains more tannin than the light wines.

Vinum Album, U. S, refers to no particular one of the numerous varieties of white wines, but to any of the group that have the required strength and purity.

While wine should have a full, fruity, agreeable taste, without either excessive sweetness or acidity, and its odor should be agreeable and free from yeastiness. It should contain not less than 10%, nor more than 12% by weight of absolute alcohol, and its sp. gr. should be not less than .99 nor more than 1.01. Sherry, Madeira, Hock and Moselle are examples of white wines.

For pharmaceutical purposes, a wine stronger in alcohol is required, than can be prepared by simple fermentation, the highest thus obtained being 13.75% by weight, or 17% by volume. For this reason, the stronger white wine, made from one part of alcohol to seven parts of white wine, by weight, containing not less than 20% nor more than 25% of absolute alcohol, is directed to be used in the medicated wines. The greater proportion of alcohol prevents acetic fermentation, and thus better preserves the preparations.

Vinum Rubrum, U. S., in like manner as the white wine, refers to no particular species of red wines, but to any that fulfills the requirements for strength and purity. [For tests see U. S. P.] Claret and the various kinds of Port are examples of red wines.

Malt Liquors are made by the fermentation of infusions of malt to which hops have been added. Malt consists of barley, which has been made to germinate by heat and moisture, after which the germination is stopped at the proper stage by elevating the temperature of the grain and drying it. In this process diastase is produced, and much of the starch is converted into sugar. Malt liquors contain a smaller proportion of alcohol than wines; usually from 5 to 8 per cent.

AMYL ALCOHOL—$C_5H_{12}O$,—OR FUSEL OIL.

Its sources have already been described. As it boils at a much higher temperature than alcohol, most of it comes over as the last product in the rectification of ordinary alcohol. But the crude amylic alcohol thus obtained contains a considerable percentage of ordinary alcohol, which is difficult to separate by fractional distillation alone. One method of removing the ordinary alcohol is to wash it repeatedly with water, and then distill it over chloride of calcium.

Character.—A thin, oily liquid, of an oppressive, penetrating odor, and an acrid, hot taste. It solidifies at 13° F., boils at 269.6° F., sp. gr. .818. It is sparingly soluble in water, and freely so in alcohol, ether and benzol.

Uses.—Solvent for some of the alkaloids, source of valerianic acid and of various compound ethers, some of which are used in flavoring and in perfumery.

Alcohols.—Ethers.

PROPENYL ALCOHOL—$C_3H_5(HO)_3$—OR GLYCERIN,

is a sweet principle derived from the various fats and fixed oils, being chemically glyceryl hydrate.

Glycerin.—Glycerinum, U. S.,—is obtained as a by-product in the manufacture of soap, and of lead plaster, or by subjecting fats to a high temperature under pressure and in the presence of water, when they are decomposed into fatty acids and glycerin, the latter passing into solution in the water.

Character.—A transparent, colorless, oily liquid, sweet and warm to the taste; sp. gr. not less than 1.25, which corresponds to 95% of absolute glycerin. Its boiling point is 554° F., but it does not distill unchanged, a portion of it being converted into acrolein and other empyreumatic products. It may, however, be distilled unchanged in a current of superheated steam, and advantage is taken of this fact in purifying it. It may be obtained, but with difficulty, in the crystalline form.*

Glycerin, like the other alcohols described, is combustible, and burns with a bluish, non-luminous flame. Like them also, there may be formed from it a series of ethers and aldehydes; Nitro-glycerin is regarded as one of its ethereal salts. It is formed by pouring glycerin drop by drop into a mixture of nitric and sulphuric acids in a vessel immersed in a freezing mixture. The resulting oily liquid is afterward purified by washing it in water. Taken internally, it is poisonous. Mixed with some inert material like infusorial earth, it constitutes dynamite.

The pharmaceutical uses of glycerin are important; it is the vehicle for the officinal glycerites, enters into the menstrua of several fluid extracts, is a constituent of the officinal tragacanth mucilage, and serves as a vehicle for other medicines.

MANNITOL—$C_6H_{14}O_6$—OR MANNITE.

A sweet substance formerly regarded as a sugar, and usually obtained from the mannas that exude from various species of Ash, particularly Fraxinus ornus and rotundifolia, that grow in Southern Europe.

It is, however, found in many other plants, in the roots of Aconite and Celery, in the leaves of the Lilac and Olive, along withcane sugar in the Sugar cane, in various Algæ and Fungi, particularly in Agaricus integer, a common fungus, which in the dry state contains nearly 20% of mannite. The manna of Tamarix mannifera, however, which is said to have constituted one of the foods of the Israelites during their wanderings in the Sinai wilderness, contains no mannite, but a true sugar.

Mannite is prepared from ash manna by dissolving the latter in half its weight of boiling water, clarifying the solution with white of egg, filtering it while hot and crystallizing. The crystals are separated from the mother liquor by draining or by pressure, dissolved in a small quantity of water, treated with animal charcoal, filtered, and recrystallized.

Character.—It crystallizes from aqueous solution in small rhombic prisms, possessing sweet taste, soluble in about 6 parts of water at 60° F., much more freely soluble in boiling water, much less soluble in ordinary alcohol than in water, and insoluble in ether. It melts and partly volatilizes at 330° F.

Uses.—A gentle laxative and cholagogue.

*The boiling point of glycerin of the sp. gr. 1.25 (1.2526) or 95%, according to Trimble should not be below 164° C. (327° F.) instead 290° C. (554° F.) as shown in the U. S. P. Glycerin is also vaporizable at a temperature below its boiling point without being decomposed (Am. Journ. Phar. Vol. XV, No. 6.) For an account of the freezing of glycerin of the sp. gr. 1.2618, see Western Druggist, Vol. VII, No. 6.

The Ethers.

The Ethers are the products of the action of acids upon the alcohols, and, as there are series of alcohols, so there are also of ethers.

They bear the same relation to the alcohols that *the oxides of the metals* bear to *the hydrates.* For example:

$(C_2H_5)HO$ is ethyl alcohol, or ethyl hydrate, and
$(C_2H_5)_2O$ is ether (sulphuric) or ethyl oxide, so
$Na(HO)$ is sodic hydrate, and
Na_2O is sodic oxide.

Ethers are of various kinds: some simple, as ethyl ether $(C_2H_5)_2O$; some haloid, that is, built on the plan of a molecule of common salt, as chlorhydric ether $(C_2H_5)Cl$; some compound, as $\left.\begin{matrix} C_2H_5 \\ \text{acetic ether } C_2H_3O \end{matrix}\right\}O$.

There are also several other kinds, of less pharmaceutical interest.

The common ethers are liquid, highly volatile and inflammable, but there are others which are dense, non-volatile, or even solid at ordinary temperatures.

The ethers of most importance in pharmacy are:

Simple....	methyl oxide,	or methylic ether.
	ethyl oxide,	or ethylic ether.
Haloid....	Ethyl chloride,	or chlorhydric ether.
	" bromide,	or bromhydric ether.
	" iodide,	or iodohydric ether.
	ethylene bichloride,	or Dutch liquid.
Compound	acetic ether,	or ethyl acetate.
	formic "	or ethyl formate.
	nitrous "	or ethyl nitrite.

Methylic Ether—$(CH_3)_2O$, obtained by distilling methylic alcohol with sulphuric acid.

Character.—A colorless, volatile, inflammable liquid at the temperature of —5.8° F., but at higher temperature a gas which is freely soluble in water, ordinary ether, methyl alcohol, and alcohol. Like ordinary ether it has anæsthetic properties. Its uses in pharmacy are limited.

Ethyl.—$(C_2H_5)_2O$—or Sulphuric Ether, obtained by distilling ordinary alcohol with sulphuric acid.

Character.—A colorless transparent, highly refractive, volatile and inflammable liquid, of a pleasant, penetrating odor, and sweetish pungent taste, sp. gr. .710 at the temperature of 68° F., boiling point about 95° F. Its vapor mixed with air forms a highly explosive compound, and hence it should be handled with care.

Æther fortior, or Stronger Ether, U. S., contains about 94% of absolute ether; the remaining 6% is alcohol with a little water; sp. gr. at 59° F. .725; boiling point 98.5° F. (Must be kept remote from light and fire.)

Ether, U. S., contains about 74% of absolute ether, and the rest is alcohol with a small mixture of water; sp. gr. .750 at 59° F.

Spirit of Ether, U. S., is a mixture of 30 parts of the officinal ether with 70 parts of alcohol.

Compound Spirit of Ether, U. S., or Hoffmann's Anodyne is a mixture of 30 parts of stronger ether, 67 parts of alcohol, and 3 parts of ethereal oil. This and the preceding spirit are used in medicine as stimulants, antispasmodics, and anodynes.

Uses.—The great value of ether in pharmacy depends on its solvent power. It stands next to alcohol in this respect, and excels it as a solvent for certain oils and resins. In medicine its most important use is as an anæsthetic. It is safer and better than chloroform.

Ethers—(Continued).

Haloid Ethers.

Ethyl Chlorides—$(C_2H_5)Cl$, or Chlorhydric Ether, is produced by the action of phosphorus pentachloride on ordinary alcohol.

Character.—A colorless, mobile, volatile and inflammable liquid, having a peculiar pleasant odor and sweetish, burning taste; boils at 54.5° F., sp. gr. .9214 at 32° F.

Ethylene Bi-Chloride—$(C_2H_4)\ Cl_2$, is allied to the foregoing. It is commonly called "Dutch liquid," and is produced by the reaction of chlorine gas upon olefiant gas.

Character.—A colorless, thin, oily liquid, with an odor like chloroform, a sweetish, pungent taste, inflammable, sp. gr. at 32° F., 1.27, boils at 185° F.

It has been used as an anæsthetic.

Ethyl Bromide—$(C_2H_5)Br$, or Bromhydric Ether, is produced by the reaction of bromine on alcohol in the presence of phosphorus.

Character.—In physical properties it somewhat resembles ethyl chloride, but is denser, having a sp. gr. at 59° F. of 1.419; boiling point 105.2° F. It is also less readily inflammable.

Used as an anæsthetic, but the dangers attending its use are similar to those of chloroform.

Ethyl Iodide—$(C_2H_5)I$, or Iodohydric Ether, is prepared by a method analogous to that adopted in the preparation of ethyl bromide.

Character.—A colorless, non-inflammable volatile liquid of a peculiar, penetrating odor; sp. gr. 1.93 at 59° F.; boils at 161.6° F.

Used for its iodine, as an inhalant in pulmonary disorders; not anæsthetic.

Acetic Ether—$(C_2H_5)\ (C_2H_3O_2)$, or Ethyl Acetate, is prepared by distilling a mixture of sodium acetate, alcohol and sulphuric acid, anhydrating the distillate by means of calcium chloride, and again distilling.

Character.—A limpid, colorless, volatile liquid, having an ethereal, and somewhat acetous odor and taste; inflammable; at 32° F., sp. gr. .9104, boils at about 168° F.

Uses similar to those of ether. It is also valuable as a solvent for many fixed and volatile oils and resins; and as an addition to perfumes.

Formic Ether—$(C_2H_5)\ (CHO)O$, or Ethyl Formiate, is produced by distillation of a mixture of sodium formiate, alcohol and sulphuric acid, the distillate being afterward rectified over calcium chloride.

Character.—A limpid, colorless, inflammable liquid, with an agreeable smell, suggesting that of peach kernels, and a pungent taste. Sp. gr. at 62.8° .918, boils at 131° F.

Uses.—As a mild anæsthetic.

Nitrous Ether—$(C_2H_5)\ (NO)O$, or Ethyl Nitrite. Formed along with other products when alcohol is acted upon by nitric acid.

Character.—A mobile, colorless liquid, with a peculiar pungent taste, and an odor resembling apples.

Sweet Spirits of Nitre—Spiritus Ætheris Nitrosi, U. S.—or spirit of nitrous ether, is an alcoholic solution of the above ether, prepared by distilling a mixture of sulphuric acid, nitric acid, alcohol and water.

Character.—A transparent, volatile, inflammable liquid with a pungent taste and a fruity odor. It contains from 4 to 5 per cent. of nitrous ether, when prepared according to the directions given in the U. S. P.; sp. gr. from .823 to 825, and its boiling point 145° F.

Uses.—As a diuretic and nervous stimulant.

Compounds related to the Alcohols and Ethers.

Chloroform — $(C\,H)Cl_3$,—Chloroformum Venale, U. S.—is one of the most important of these.

Its molecule is like that of methyl hydride, CH_4, except that three of its hydrogen atoms are replaced by chlorine, and it belongs therefore to the methyl series of compounds.

Preparation.—It may be obtained by the action of bleaching powder on various organic compounds, or by the action of caustic soda on chloral hydrate. It is usually made by distilling strong ethyl alcohol with a mixture of bleaching powder and water. The distillate, washed with water, constitutes crude chloroform, which is of value in pharmacy as a solvent and in the preparation of liniments, but should never be used internally.

Full directions are given in the Pharmacopœia for the preparation of purified chloroform from the crude article.

Purified Chloroform. — Chloroformum, U. S. — A heavy, clear, colorless liquid of a characteristic pleasant ethereal odor, a burning sweet taste and a neutral reaction. It is soluble in about 200 parts of water and in all proportions in alcohol or ether; also in benzol, benzin and fixed or volatile oils. Its sp. gr. is 1.485 to 1.490 at 59° F. It boils at 140° to 142° F. and contains $\frac{3}{4}$ to 1 per cent of alcohol.

Tests.—When agitated with twice its volume of water, the latter should be (1) neutral to blue litmus-paper (absence of acids), (2) should not affect test-solution of nitrate of silver (chlorides), nor (3) test solution of iodide of potassium (free chlorine). No foreign odor should be noticed when a few drops are permitted to evaporate from a piece of blotting-paper. (For further tests see U. S. P.)

Uses.—Chiefly as an anæsthetic. It is doubtless less safe than ether, but most of the accidents that happen from its proper use as an anæsthetic may be attributed to the impure quality of the cloroform, and it cannot, therefore, be too strongly insisted upon that the tests of purity required by the Pharmacopœia be carefully applied to all chloroform sold for this purpose.

Officinal Preparations.—Chloroformum Purificatum; Chloroformum Venale; Mistura Chloroformi; Spiritus Chloroformi.

Chloral Hydrate—$C_2HCl_3O+H_2O$.—Chloral, U. S., is another important substance.

It is obtained by passing dry chlorine gas into absolute alcohol. A solid mass is thus obtained which is treated with sulphuric acid, and the chloral separates as an oily layer. This is purified by distillation over quicklime, and hydrating the product by adding the necessary amount of water.

Character.—The crystals of the hydrate are deliquescent in moist air, and slowly sublime in dry air. It fuses at 136° F. to a clear, colorless liquid of the sp. gr. 1.575; it boils at 203° F. and evaporates without leaving a residue.

Uses.—As a hypnotic, but is attended with some danger; as an overdose may produce fatal consequences, great care should be used in dispensing it, and only such samples as answer the Pharmacopœial tests for purity should be dispensed for internal use, namely, the crystals.

Starches.—Sugars.

The Carbo-Hydrates.

The carbo-hydrates include the starches, sugars, cellulose or cellulin, lignin and the gums.

They are closely related chemically, and agree in containing the *hydrogen and oxygen in the same proportion* in which these elements occur in the *water-molecule.*

In the processes of vegetable life, all the others appear to be produced either directly or indirectly from starch.

Starches.

Starch appears to be the first product of the assimilative process in the plant, and is made directly from water and carbon dioxide by the agency of chlorophyl and sunlight. It first makes its appearance in the chlorophyl bodies, where, by means of a good microscope, aided by appropriate tests, it may be discovered; it then passes into some soluble form, as glucose, dextrin, or some other of the many forms of sugar, and is carried in the sap of the various parts of the plant, and either again stored up as starch in the roots, seeds, etc., or converted into fixed oils for the future uses of the plant, or it is formed into cellulose, lignin, suberin, gum, or, by reactions with nitrates or ammonia compounds and sulphates, it is converted into proteid compounds.

Starch is, in other words, the formative material of the plant, from which, in the long run, all its tissues are built up.

Starch.—Amylum, U. S.—has the chemical formula, $C_6H_{10}O_5$, or some multiple of this. It usually exists in the cells in the form of minute granules.

They are found most abundantly in those parts of the plant which serve as storehouses for reserve material, as in seeds, in biennial or perennial roots and thickened rhizomes, in the pith of some plants, as the sago palm, but often, also, in the leaves, bark, and even wood. The granules differ widely in shape and size, but often particular forms are so characteristic of certain species of plants that their source may be determined by microscopical examination. Usually the grains possess a nucleus or hilum which is sometimes centrally and sometimes excentrically located, and around this nucleus concentric markings are frequently seen.

The starch grain is not homogeneous in composition, but is composed of two different substances, *granulose* and *starch cellulose*, in the proportion of from 2 to 6% of the latter and from 94 to 98% of the former. By digesting starch with saliva for some time at the temperature of about 100° F., the granulose will be dissolved, leaving a perfect skeleton of the grain in starch cellulose. These two substances re-act differently with iodine, granulose being stained a deep violet color, while starch cellulose only requires a yellowish or brownish color with the same reagent.

Owing to the staining effect which iodine has upon granulose, it constitutes the best reagent for detecting the presence of starch.

Character.—Insoluble in cold water, but forms a mucilage or paste with hot water.

Official Preparations.—Glyceritum Amyli; Amylum Iodatum.

The most important sources of commercial starch are the grain of Indian corn, the tubers of the potato, the grains of rice, the rhizome of Maranta arundinacea (Arrow root), the pith of the sago palm, the root of Manihot (Tapioca), and the rhizome of Canna.

A large number of isomers of starch are known, among the more important of which are the Dextrins, Lichenin, Inulin, and Glycogen.

The *Dextrins* are soluble in water, and do not re-act with iodine to produce a violet color. As found in the plant they probably represent transition stages in the process of change from starch to the sugars. It may be produced artificially by heating starch for a little time to a temperature between 437° and 500° F.

Lichenin is the peculiar form of starch which is found in Iceland moss. It is soluble in hot water, but is precipitated from it again as a gelatinous mass on cooling.

Inulin replaces starch in the roots of Dahlia, Inula, Taraxacum, Cichorium, and other Compositæ. In its properties it stands between starch and sugar. It is slightly soluble in cold water, freely so in hot, and is soluble in absolute alcohol. It is not colored blue by iodine, and is very hygroscopic.

Lævulin is found associated with inulin in some of the Compositæ, and with ordinary starch in the young grain of Rye. It is amorphous, and deliquescent, and is soluble in dilute alcohol.

Glycogen is the peculiar form of starch found in the liver of man and many other animals. It is an amorphous white powder, soluble in water, and its aqueous solution is colored wine-red by iodine.

These starches form a group called the Amylum Group. They are all transformed by the action of acids into glucoses.

Sugars.

The Sugar Group consists of compounds closely related to the starches, but they are crystalline, sweet or sweetish to the taste, and more or less soluble in water.

They are divided into two classes, the saccharoses and glucoses.

The *Saccharoses*, of which common cane sugar is the type, have the formula $C_{12}H_{22}O_{11}$. The principal members of the group are:

Cane sugar,	Milk sugar,	Melezitose,
Melitose,	Trehalose,	Maltose.

They are all characterized, optically, by deviating the plane of polarized light to the right, and chemically by being convertible by boiling with dilute sulphuric acid into glucoses. They differ also from the glucoses in not being directly fermentable.

Cane Sugar.

Cane sugar, the most important member of the group, is widely distributed in the vegetable kingdom, but its principal commercial sources are the sugar cane, the sugar beet, certain of the palms, and the sugar maple. The sugar is contained in solution in the sap of these plants.

The process of obtaining it from the sap varies with the different sources, but consists essentially in the following:

(1) Getting rid of albuminoid impurities by treatment with milk of lime, or some other suitable substance.

(2) Concentration by evaporation and the separation of the crystallizable from the uncrystallizable portion

(3) Refining the crude crystalline product by dissolving it, treating it with animal charcoal and albuminous substances, thus removing coloring matters and other impurities, then concentrating and crystallizing

Sugars.—Glucoses.—Cellulose.

Sugar.—Saccharum, U. S.—The refined sugar of Saccharum officinarum Linné.

Character.—Pure cane sugar crystallizes in colorless crystals of sp. gr. 1.593. A saturated solution in water at 32° F. contains 65% of sugar. Boiling water dissolves it in all proportions, but it is nearly insoluble in absolute alcohol. Its melting point is about 320° F.; when heated to a higher temperature it gradually undergoes change, and is converted into Caramel. More strongly heated, the caramel is decomposed, and a mass of porous charcoal is left behind.

Many compounds of sugar, with bases, are known, but only one, the saccharate of calcium, is of importance in pharmacy, under the name of Syrupus Calcis.

Other Saccharoses are the following:

Milk Sugar—Saccharum Lactis, U. S.—occurs in the milk of mammalia. In Switzerland and other parts of Europe it is prepared from whey by evaporating it to a syrup, allowing it to stand and crystallize, and then purifying by re-crystallization.

Character.—Crystalline, less sweet to the taste than cane sugar, sp. gr. 1.534, soluble in 7 parts of cold and in 2.5 parts of boiling water, but quite insoluble in absolute alcohol.

Melezitose is a peculiar sugar found in certain mannas, particularly Abies larix.

Melitose forms the principal constituent of the manna that exudes from Eucalyptus manifera and some other species of the same genus. It is in the form of fine felted needles, which contain three molecules of water of crystallization.

Trehalose, sometimes called mycose, occurs in ergot of rye, in Agaricus sulphureus, and several other fungi.

Maltose is a peculiar sugar obtained by treating starch-paste with malt. It crystallizes in fine needles.

Glucoses.

The glucoses, of which common grape sugar, or Dextrose, is the type, have the formula $C_6H_{12}O_6$.

They differ from the saccharoses in being directly fermentable. There are many varieties, the more important of which are these:

Dextrose, or grape sugar.	Galactose.
Levulose, or fruit "	Arabinose, and Inosite.

Dextrose, so-called, because it rotates the plane of polarization to the right, is widely distributed in the vegetable kingdom, often occurring associated with cane, fruit and other sugars. It was first obtained from grapes, and hence is called grape-sugar. It is now manufactured on a large scale from starch, by the action of dilute sulphuric acid upon it. The process takes place in two stages: dextrin being first produced, and then afterward, by the continued action of the acid and heat, this is converted into glucose.

Character.—It occurs in market in the solid and liquid forms. The former is whitish, and semi-crystalline, and much less sweet to the taste than cane-sugar. The liquid form is usually a mixture of glucose, maltose, dextrin and water in varying proportions. Besides being used somewhat in pharmacy to increase the body of syrup without producing a corresponding increase in sweetness, it is used extensively by brewers in the manufacture of sparkling ales, etc., and in the adulteration of table syrups.

Levulose is found associated with grape-sugar in fruits, and is commonly called fruit sugar. It differs optically from dextrose or grape sugar, by rotating the plane of polarization to the left instead of the right. It is a colorless, uncrystallizable syrup, and is nearly as sweet as cane sugar. It is obtained from inulin by treating it with dilute sulphuric acid.

Galactose is a peculiar sugar derived from milk sugar by the action of dilute sulphuric acid. It rotates the plane of polarization to the right.

Arabinose is a sugar obtained by boiling gum arabic in dilute sulphuric acid. It differs but little from galactose.

Inosite was first found in muscles of animals, and hence is called muscle sugar; but it is now known to occur also in some plants. It is crystalline, sweet, soluble at 60° F. in about 6 parts of water, and insoluble in absolute alcohol.

Cellulose.—$C_6H_{10}O_5$.

Cellulose, or cellulin, has the same composition as starch, and like it can, by the action of acids, be converted into glucose.

It constitutes the principal portion of the cell-walls of plants, and along with one of its modifications, lignin, it constitutes the greater proportion of the weight of dried wood.

It occurs in a very pure form in the pith-cells of certain plants, but one of its purest forms is cotton-fiber, or the hairs taken from the seed of the cotton plant. They consist of single, elongated, rather thin-walled cells, which, when dry, collapse, and form flattened and somewhat twisted bands. But cotton fibers are not absolutely pure cellulose; they contain some oily matter, as well as traces of albuminoids. They are purified by boiling in a 5% solution of caustic potash, thoroughly washing, expressing the liquid, immersing it for a few minutes in a 5% solution of chlorinated lime, washing again, first with water, then with dilute chlorhydric acid, washing a second time and expressing the water, and again boiling for a few moments in a 5% solution of caustic potash, washing once more, first with water, then with water slightly acidulated, and lastly, washing with pure water, and drying. This constitutes the Purified, or Absorbent Cotton.

Cotton.—Gossypium, U. S.—An excellent absorbent for watery fluids, and therefore used frequently as a dressing for burns, blisters, etc. It is also used in the preparation of pyroxylin.

Character.—Pure cellulose is stained yellowish or brownish-yellow by iodine, but if afterward treated with dilute sulphuric acid, it turns blue.

There are various forms of modified cellulose, chief among which are lignin and suberin.

The cell-walls of wood and other thick-walled cells in the process of growth soon become covered with a deposit of material resembling cellulose, and having the same chemical elements in the same proportion, but it is stained a deep brown by iodine and sulphuric acid. This is *lignin.*

Suberin is a modification of cellulose that incrusts the cell-walls of cells in the corky layer of the bark. It constitutes the principal portion of cork, and is convertible by the action of a boiling solution of caustic potash into a yellowish oily liquid called cæric acid.

If pure cellulose be treated with a mixture, in certain proportions, of nitric and sulphuric acids, and thoroughly washed and dried, an explosive substance called pyroxylin, or gun-cotton, is produced.

Collodion.—Collodium, U. S.—A solution of 4 parts of pyroxylin in 26 of alcohol and 70 of stronger ether.

Other officinal preparations are: Collodium cum Cantharide; Collodium flexile; Collodium stypticum.

Care of course should be exercised not to bring collodion, or any of its preparations, near a flame.

Gums.—Volatile Oils.

Gums.

The Gums are bodies closely related in their chemical structure to starch and cellulose. They are common vegetable products, but seldom occur in the animal kingdom.

They exude from many plants when the bark is punctured, and appear to perform the function of plugging up the wounded vessels and facilitating the healing process. They are produced, mostly at least, by the transformation of the cellulose or the substance of the cell-walls of plants.

The chemical formula also of many of them is identical with that of cellulose, while others possess an additional molecule of water.

Some are soluble in water, others only swell up but do not properly dissolve, and by reason of this difference they may be divided into two groups, only one representative of each, however, being officinal:

Acacia, or Gum Arabic—Acacia, U. S.—derived from various species of Acacia, particularly Acacia verek, may be taken as the type of the foster group. The greatest portion of a good quality of gum arabic consists of arabin or arabic acid.

It may be prepared from the aqueous solution of the gum by acidulating it with chlorhydric acid and adding alcohol. The impure arabin thus precipitated may be purified by repeated solutions and precipitations. It is, when moist, a milk-white gummy substance, and has a distinct acid reaction.

Character.—Bland and sweetish to the taste, sp. gr. 1.3 to 1.5; its solution is coagulated by borax into a light-yellow mass, and by ferric chloride into a reddish jelly; boiled for some time with dilute sulphuric acid, it is converted into glucose.

It is employed extensively in the arts for a variety of purposes, as in the manufacture of mucilage, in the preparation of water-colors, in the preparation of ink, in order to hold in suspension the fine particles of tannate of iron; and in pharmacy it is used in the preparation of emulsions, pill masses, pastes, syrups, etc.

Offi. Prep.—Mucilago Acaciæ; Syrupus Acaciæ.

Tragacanth, or Gum Tragacanth — Tragacantha, U. S.—an exudation from the stems of various species of Astragalus, consists in large part of an insoluble gum called bassorin. It contains also some starch, cellulose, and a small quantity of soluble gum similar to arabin, if not identical with it.

Officinal Preparation.—Mucilago Tragacanthæ.

Cerasin, found in the gummy exudation from cherry trees, resembles tragacanth in its properties.

A considerable number of drugs in the Materia Medica owe their virtues chiefly or wholly to mucilages, which really belong to one or the other of these two groups. Examples of these are:

Salep, tuber of Orchis mascula,
Ulmus, bark of Ulmus fulva,
Sassafras medulla, pith of Sassafras officinale,
Cydonium, Seed of Cydonia vulgaris,
Althæa, root of Althæa officinalis,
Linum, seeds of flax, Linum usitatissimum, etc.

The Pectins and pectic acids are also closely related to the gums.

Essential Oils.

The Essential or *volatile* Oils bear some resemblance in their appearance and physical properties to the *fixed* oils or fats, but they *differ* from them, (1) in chemical composition, (2) in not leaving a permanent stain upon paper, (3) in being more or less volatile at ordinary temperatures, (4) in the fact that they may be completely volatilized by heat without undergoing any chemical change, and (5) in not being saponified by alkalies.

They are slightly soluble in water, but soluble in all proportions in alcohol, ether, and the fixed oils; they are all inflammable, and all burn with a smoky flame. In specific gravity they range from .82 to 1.18, but by far the larger portion of them are lighter than water. Their boiling point is higher than that of water—in most cases above 284° F. They are supposed to be perfectly transparent and colorless when pure, but all undergo change on standing, being partly converted into resin, and acquire various, often characteristic, colors.

As to their origin, few occur in animal structures, but they are widely distributed in the vegetable kingdom, and their varieties are very numerous. Sometimes they are diffused through the entire structure of the plant, sometimes they are confined to a part, as to the flower, or the fruit; sometimes they occupy separate cells, or conceptacles, as in the rind of the orange, and the oil tubes in the fruits of the Umbelliferæ. They are usually found associated with resins, and hold them in solution. For the plants that produce them they serve various purposes. The turpentine of pines, and oil of mustard and horseradish are doubtless protective, while those volatile oils that give rise to the pleasant odors of certain flowers, serve the purpose of attracting winged insects that aid in cross-fertilization.

The volatile oils are extracted in various ways:

(1) By expression, as in the case with the oils of orange, lemon and bergamot, where the oil is secreted in conceptacles in the rinds of the fruit.

(2) By distillation with water.

This is usually done in copper stills, lined with tin. Sufficient water is put in to cover the material and prevent the formation of empyreumatic products. Usually a perforated metal diaphragm is placed inside the still to keep the material down beneath the surface of the water. The water is now made to boil vigorously, and the oil distils over along with the water. When the distillate cools, the oil, except a small portion which is dissolved, separates from the water in a layer usually at the top, and may be drawn off. In case the tissues are of such a character that water does not readily penetrate them, as in sandalwood, or where the oil is small in quantity, the water from the distillate is returned to the still, and the process repeated, either upon the same, or upon a fresh portion of the material. Most volatile oils, although their boiling points are higher than that of water, owing to their volatility, distil readily in this way, but in case the boiling point of the oil be very high, common salt is sometimes added to the water, to raise its boiling point, or the process is hastened by passing a current of steam into the bottom of the still.

(3) By extraction with a volatile solvent.

The material is extracted with bisulphide of carbon, which dissolves out the oil, after which the bisulphide is permitted to evaporate, leaving the volatile oil mingled with some impurities, from which it is freed by distillation. Other solvents, as petroleum benzin and ether, are sometimes used in place of the bisulphide of carbon.

Essential Oils—(Continued).

(4) By the process of enfleurage.

The process of distillation, though more speedy and convenient, is too wasteful where it is desired to collect the delicate volatile essences of flowers, which frequently are present in the flowers only in minute proportions: so, for this purpose, the process of enfleurage is usually adopted.

It consists in sprinkling the material, from which the essence is to be extracted, on the surface of some purified and odorless fat contained in shallow trays. The fat after a time takes up the essence, and the exhausted material may be replaced by fresh and the process continued until a strongly perfumed pomade is obtained, If this pomade be now treated with absolute alcohol the essence is dissolved, while but little of the fat passes into solution, and that little may be separated by exposing the alcoholic solution to a low temperature, when the fat crystallizes out. The product thus obtained is the "extract" of the perfumers. The volatile oil may be obtained from this by treating it with water, when the oil separates out.

Preservation.—Volatile oils undergo changes by standing. These are due partly to the effects of light and partly, probably, to the oxidizing influence of the air. The changes are greatly retarded if the oils be kept in full, tightly stoppered bottles and in a dark place. Oils that have become discolored by age may be greatly improved by rectification. This is best accomplished by mixing them with an equal bulk of odorless fat and distilling them from a solution of common salt in water.

ADULTERATIONS.

Volatile oils are liable to be adulterated with (1) fixed oils, (2) alcohol, and (3) with other (cheaper) volatile oils.

Fixed oils may be detected by placing a drop of the suspected oil upon clean writing paper; if present, the oil will leave a permanent stain. Also fixed oils, if present in considerable quantity, will be separated on the addition of alcohol.

Alcohol may be detected by observing whether or not contraction takes place when measured quantities of the oil and water are mixed in graduated glass tube. If contraction takes place, alcohol is present, and the amount of contraction indicates the the quantity of alcohol present.

Also if some fixed oil, as olive oil, that is insoluble in alcohol, be added, alcohol, if present (except in very small quantity), will separate out. *Red anilin* may also be used as a test, as it is soluble in alcohol but entirely insoluble in the volatile oils. If, therefore, the sample tested is colored red, it indicates the presence of alcohol as an impurity.

Admixture of other, cheaper, volatile oils is more difficult of detection.

It is usually the case that if a drop of mixed oils be evaporated, either from the hand or from a sheet of paper warmed over a lamp, the difference may be be detected by observing the odor from time to time, as one of the essential oils is likely to volatilize more rapidly than the other.

If the oxygenated oils are adulterated with hydrocarbon oils, as is likely to be the case on account of their cheapness, their presence may often be detected by treating a portion of the suspected oil with 85 per cent. alcohol, in which the hydrocarbons are less soluble than oxygenated essences, and will therefore separate out.

In judging of essential oils by the sense of smell, particularly if they are alcoholic solutions, it is always better to rub a drop on the hand and then smell of it, than to smell it directly from the bottle, as in the latter case the pungent odor of the alcohol, if present, obscures the odor of the essence, and evaporation of the oil can not take place so rapidly from the liquid surface in the bottle as from the warm hand.

The volatile oils, or "Ethereal oils," as they are more correctly termed, enter largely into medicinal preparations, sometimes for the sake of flavor, as in the officinal spirits or "essences," sometimes as aromatic stimulants, as in the medicated waters or in the Elæosacchara of the Ph. Ger.; but more frequently as correctives of nauseous drugs.

The essential oils may be classified according to their composition into:

(1) Hydro-carbons; (2) oxygenated oils; (3) sulphurated oils; (4) nitrogenated or complex oils, and (5) empyreumatic oils.

The Hydrocarbons, so called because they are composed entirely of carbon and hydrogen, nearly all have the formula $C_{10}H_{16}$.

They are mostly derived from three orders of plants, the Coniferæ, Piperaceæ and Leguminosæ.

They are characterized (1) by having a *lower* specific gravity than those of the other groups, (2) by their being *less* soluble in water, and (3) by their being converted into *solid resins* by the action of nitric acid.

The officinal oils of this class are:

Oil of Copaiba—Oleum Copaibæ, U. S.—derived from various species of the genus Copaifera; transparent, colorless; sp. gr. .87 to .91.

Oil of Cubebs—Oleum Cubebæ, U. S.—derived from the fruit of Cubeba officinalis; a colorless or greenish liquid; sp. gr. from .92 to .93. It is turned red by sulphuric acid.

Oil of Juniper—Oleum Juniperi, U. S.—derived from Juniperus communis; a colorless liquid, sp. gr. from .85 to .91. It fulminates strongly with iodine.

Oil of Savin—Oleum Sabinæ, U. S.—derived from the leaves of Juniperus sabina; a colorless liquid; sp. gr. from .89 to .94. It fulminates strongly with iodine.

Oil of Turpentine—Oleum Terebinthinæ, U. S.—derived from several species of Pine; colorless; sp. gr. from .86 to .90. It fulminates violently with iodine.

The Oxygenated essences differ chemically from the preceding class, in containing a small proportion of oxygen.

They are also *more soluble in water*, have a *higher sp. gr.;* this ranges from .82 to 1.09; and they may, with a few exceptions, be separated by fractional distillation into *a more volatile elaeopten*, and *a less volatile stearopten*, or camphor.

This group includes by far the larger proportion of all the essences used in perfumery, as the oils of rose, mignonette, violet, Ihlang-ihlang, etc., and nearly all those which in medicine are used as carminatives. It is to them also, for the most part, that the spices and savory herbs used in cookery owe their taste and odor.

Their use in medicine is chiefly as carminatives and stimulants, to cover the taste of other medicines or act as a corrective to their action; but some, as that of valerian, have value as antispasmodics, and others, as that of rue, are used as emmenagogues.

Essential Oils—(Concluded).—Camphors.

The officinal oxygenated oils are:

	Part of	Plant.	
Oil of Anise	fruit	Pimpinella anisum.	
Star Anise	seed	Illicium anisatum.	
Neroli	flowers	Citrus vulgaris.	Mixtures of hydrocarbons with oxygenated oils.
Bergamot	fruit	" limetta.	
Orange	"	" vulgaris.	
Lemon	"	" limonum.	
Cajeput	leaves	Melaleuca cajuputi.	
Caraway	fruit	Carum carui.	
Cloves	flower buds	Eugenia Caryophyllata.	
Wormwood	seed	Chenopodium anthelminticum	
Cinnamon	bark	Cinnamomum aromaticum and " Zeylanicum.	
Coriander	fruit	Coriandrum sativum.	
Erigeron	herb	Erigeron Canadense and " Philadelphicum	
Eucalyptus	leaves	Various species of Eucalyptus[1]	
Fennel	fruit	Foeniculum vulgare.	
Wintergreen	herb	Gaultheria procumbens.	
Pennyroyal	"	Hedeoma pulegioides.	
Lavender	" &flo's.	Lavandula vera.	
Peppermint	"	Mentha piperita.	
Spearmint	"	" viridis.	
Bay	leaves	Myrcia acris.	
Nutmeg	kernel & aril.	Myristica fragrans.	
Allspice	fruit	Eugenia pimento	
Rose	petals	Rosa Damascena.	
Sandalwood	from wood.	Santalum album.	
Sassafras	bark	Laurus sassafras.	
Thyme	herb	Thymus vulgaris.	
Rosemary	"	Rosmarinus officinalis.	
Rue	"	Ruta graveolens.	
Valerian	root	Valeriana officinalis.	

Many drugs, also, whose oils are not officinal, owe their activity, in part at least, to the presence of oxygenated oils.

The Nitrogenated or complex oils are but few in number, and the plants which yield them all belong to the Rosaceæ, and most of them to the suborder Amygdalæ. They contain prussic acid in solution in the oil, and are therefore poisonous.

Their specific gravity varies from 1.04 to 1.07, boiling points from 320° to 390° F., and they are acid to litmus paper.

The most important of this group are: Oil of cherry-seeds, oil of cherry-laurel leaves, and:

Oil of Bitter Almonds—Oleum Amygdalæ Amaræ, U. S.—Obtained from the seeds of bitter almonds by crushing them, macerating with water, and afterward distilling.

The Sulphureted oils constitute a series of pungent essences characterized chemically by containing a small proportion of sulphur. Most of these oils are obtained from plants belonging to the natural order Cruciferæ, but oil of asafœtida is derived from an Umbelliferous, and oil of garlic from a Liliaceous plant.

Volatile Oil of Mustard—Oleum Sinapis Volatile, U. S.—Is obtained from black mustard seed by maceration with water, and subsequent distillation. It occurs, however, in other Cruciferous plants.

A colorless, pungent and acrid liquid; sp. gr. from 1.017 to 1.02; boils at 298° F. Its chemical formula is (C_3H_5) (CNS). It is therefora a *sulpho-cyanide.*

Oil of Horse-radish has the same composition.

Oil of Asafœtida has the formula $C_{12}H_{22}S$, or $C_{12}H_{22}S_2$, and *Oil of Garlic* $C_6H_{10}S$ mixed with $C_6H_{10}O$.

The empyreumatic volatile oils are those obtained by dry distillation of organic substances, or, as in the case of the petroleums, they may be produced by the slow decay, under certatn conditions, of organic materials. To this group belong:

Oil of Amber—Oleum Succini, U. S.—Obtained by the destructive distillation of amber, and purified by *rectification.*

Oil of Birch, from the destructive distillation of birch bark.

The *Petroleum* products, kerosene and paraffin; pyrene and napthalin from coal tar, and a great many other substances.

They form a miscellaneous collection, differing a good deal from each other in their chemical structure as well as in their physical properties. They agree in being but little affected by cold nitric acid, and in *not fulminating* with iodine.

Camphors.

Closely allied to the volatile oils are the camphors, and some of the volatile oils may by long exposure to water and the atmosphere be converted into camphors.

Common camphor is derived from the wood, branches and roots of Camphora officinarum, a tree which belongs to the Lauraceæ, and grows in Eastern and Southeastern Asia.

The camphor is obtained by distillation of the chips with water, and the product is afterward purified by sublimitation.

Camphor ($C_{10}H_{16}O$)—Camphora, U. S.—Sp. gr. about .99, volatile at ordinary temperatures, fuses at 347° F., boils at 401° F., and burns with a yellowish, sooty flame.

Owing to the toughness of its crystals, it cannot be pulverized in a mortar unless first moistened with alcohol, ether, or volatile oil. It may, however, be obtained in a finely divided state by condensing the hot vapors.

Borneo Camphor is of different composition, and has the formula $C_{10}H_{18}O$. It is derived from fissures in the wood of Dryobalanops camphora, a tree belonging to the Dipterocarpaceæ. It grows in the islands of Borneo and Sumatra.

This camphor is slightly heavier than water, is less volatile; and by the action of nitric acid is converted into ordinary camphor.

Camphora monobromata, $C_{10}H_{15}BrO$, a combination of camphor and bromine. It has similar uses in medicine to those of the bromide compounds.

Officinal Preparations.—Aqua Camphoræ; Ceratum Camphoræ; Ceratum Plumbi Subacetatis; Linimentum Belladonnæ. Linimentum Sinipis Comp.; Mistura Chloriformi; Spiritus Camphoræ, Tinctura Opii Camphoratæ.

With the Camphors may be classed the following substances.

Thymol.—Thymol, U. S.—Obtained from the volatile oils of several plants belonging to the Mint-tribe.

By fractional distillation the terpenes are separated and the portion coming over at 374° F. is treated with soda, decomposed by hydrochloric acid and the thymol crystallized from an alcoholic solution.—(For tests see U. S. P.)

Menthol $C_{10}H_{20}O$.)—Is a stearopten obtained by fractional distillation from American and Japanese peppermints.

It has been used extensively as a topical application in nervous headache.

1 Hydro-carbons and oxygenated oils; one contains hydrocyanic acid.

Questions on Lecture IV.—Series 7, 1891.

1. What is the difference between a Pharmaceutical and a Pharmacopœial preparation?
2. What is the general method of the U. S. P. for the preparation of Medicated Waters?
3. What is the difference between Waters and Liquors?
4. If a liquid preparation be made after a certain formula, employing in one instance the Metric system of weights, in another Avoirdupois weights, what difference would there be in the *strength* of the products?
5. How are Mucilages prepared?
6. What is the strength of the natural Wines of the U. S. Pharmacopœia?
7. What is the difference between Syrups and Honeys?
8. What is the difference between Liniments and Oleates?
9. State the percentage of drug contained in the Tinctures of Green Soap, Gentian Compound and Aconite.
10. By what different methods are the officinal Tinctures prepared?
11. What is the officinal Elixir?
12. What other officinal preparations may be prepared from a Tincture of Podophyllum?
13. In what particulars does the method of preparation of the Syrup of Rhubarb differ from that of the Fluid Extract?
14. Which gives the greater yield of Extract, an aqueous menstruum or an alcoholic menstruum?
15. Which of the officinal Mixtures are emulsions?
16. Which of the officinal Tinctures are made by solution?
17. How is Mel Despumatum prepared?
18. What advantages have the Abstracts over powdered Extracts?
19. State the general formula for the preparation of Triturations.
20. Name the officinal Triturations.
21. How many fluid ounces of Dilute Alcohol U. S. can be prepared from 12 fluid ounces of 65 per cent. Alcohol?
22. What is the best *excipient* for the following pills:
    (*a*) Iron Reduced, 1 gr.; Quinine Sulph., 1 gr.
    (*b*) Ext. Colocynth Comp., 1 gr.; Ext. Belladonna, ⅛ gr.; Resin Jalap, ⅛ gr.
23. How would you *prepare* the following ointment:
    Ext. Hyoscyamus, 1 dr.; Acid Tannic, 1 dr.; Benzoinated Lard, 14 drams.
24. Give the method by which the following are *mixed* for suppositories:
    Acid Tannic, 30 grs.; Extract Opium, 30 grs.; Ol. Theobroma, 1 oz. Troy.
25. Which is the most important of the officinal simple Plasters? Give briefly the essentials of the process for its preparation.
26. Mention an important By-product.

IMPORTANT.

Students will please reply to the above questions on *letter-size* paper, *in ink*, writing only on *one* side of the paper, and forward promptly to the director, signed. In answering, it is *not* necessary to repeat the question itself but only the *number* of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

☞ In order to insure prompt attention all the rules of the "Important Notice" must be complied with.

National Institute of Pharmacy.

LECTURES, SEMI-MONTHLY, BY MAIL.
C. S. HALLBERG, Ph. G., *Director.*

DEPARTMENT OF EXAMINATIONS.

CHICAGO, Aug., 1891.

C. F. Carpenter, East Hampton, Conn.

Upon Questions on Lecture V, Series 7. we transmit the following printed answers for further comparison and study:

1. Monobasic acids form only Normal or Neutral salts; Dibasic acids, Normal, Acid, or Double salts.
2. Carbon.
3. Mineral and organic impurities, among them being Sulphuric and Nitric Acids.
4. Coal Tar.
5. Carbolic Acid and Thymol.
6. By appearance, odor and solubility.
7. *a.* Benzoic and Cinnamic Acids.
   b. Refer to dispensatories.
8. ———
9. Refer to U. S. P. or dispensatory.
10. Carbolic, Cresotic, Sulphuric and Hydrochloric Acids.
11. Alcohols are the hydrates of certain organic radicals, whereas Ethers are the oxides.
12. 10 to 12 per cent in White and Red Wines, and 20 to 25 per cent in stronger White Wine.
13. They are prone to undergo Acetic Fermentation,
14. Alcohol, glycerin, phenol and thymol.
15. *a* It is Amyl Hydrate, a higher homologue of alcohol.
    b. By filtration through Animal Charcoal.
16. By prolonged action of Chlorine on Alcohol, followed by hydration and crystallization.
17. $C_2 H Cl_3 O$ or trichloraldehyde.
18. Spirit of Chloroform.
19. Refer to lecture.
20. ———
21. Saccharoses or Sucroses and Glucoses.
22. ———
23. Distillation, Expression and Enfleurage.
24. By double decomposition between a soluble Lead salt and a solution of Soap. See page 95 of the National Formulary.
25. *a.* Oxygenated.
    b. Sulphuretted.
    c. Nitrogenated,
    d. Hydrocarbon.
26. Difference in derivation and reaction with Iodine.
27. Refer to lecture.

Your rating on answers to Lecture 5 *is* 85 *per cent.*

The abbreviations "P.," "Col." and Par.," are used to indicate "page," "column," and "paragraph," respectively.

In rating the answers, your *general understanding of the subjects* and the *appearance of your paper*, are also taken into consideration.

☞ The above questions should be *carefully reviewed* upon receipt of corrections. If questions to any other Lectures remain unanswered, please send them in at once.

THE DIRECTOR.

Always continue to answer in the regular order without waiting for delayed observations. Corrections are always forwarded as promptly as possible.

☞ **NOTICE.—Do not fail to write your name, full address and CLASS page** 627, **at the TOP of the first page of your answers.**

In all correspondence the CLASS page must be stated in order to insure prompt attention.

Resins.

Resins are solid, usually amorphous vegetable products, commonly with a conchoidal fracture, soluble in alcohol and usually also in the fixed oils, but not in water, transparent or semi-transparent, readily fusible, inflammable, and burning with a sooty flame, not volatilizing without undergoing chemical change, and negatively electrified by friction. Some contain acids, and with the alkalies are capable of forming soaps; others are neutral, and can not be saponified.

Composition.—Resins are complex bodies, being mostly mixtures of different compounds of carbon, oxygen and hydrogen. Shellac, for instance, consists of five different resins and a coloring matter. Amber is a mixture of succinic acid and several resins; Sandarac consists of three resins, which differ in solubility, but are not soluble in water, and a fourth constituent, a bitter principle, which is soluble in water.

Origin.—The resins are widely distributed through the vegetable kingdom, there being very few plants that are entirely destitute of them, while some secrete them in large proportion. Sometimes they are diffused through all the tissues of the plant, and sometimes they are collected together in certain parts, as in the heart-wood in Guaiac; sometimes they are accumulated in certain special secretion cells, and these cells may be isolated, collected together in masses, or coalescent, forming tubes or ducts; or the secretions may be poured into intercellular spaces, and these may be small isolated areas, or they may form tubes in the leaves, wood or bark, following the direction in length of the organ in which they occur.

The mode of formation of the resins is obscure, but they are probably to be regarded as degradation products, resulting from the partial breaking down of vegetable tissues. It has been observed in some instances that, as resin accumulates in a tissue, the cell-walls of that tissue become thinner and finally disappear. Resin would appear, therefore, to be, in these cases at least, the product of the retrograde metamorphosis of cellulose or lignin. But that the change is not immediate, but first into volatile oil and then into resin, is indicated by the fact that most volatile oils, on standing exposed to light and air, partially change into resin, and also by the fact that resin appears always to exist in the plant associated with volatile oil.

Some of the resins are used medicinally but the larger portion of them are chiefly valuable for varnishes.

The most important natural resins are:

Guaiac,	Copaiva,	Elaterium,	Mastich,
Copal,	Dammar,	Sandarac,	Lac,
Colophony,	Amber,	and Asphalt.	

The extracted resins have been treated elsewhere (see Lecture IV).

Guaiac.—Guaiaci Resina, U. S. Product of Guiacum officinale, and G. sanctum, West Indian and South American trees, belonging to the natural order Zygophyllaceæ. It is most abundant in the heart-wood.

Obtained partly from natural exudations, partly from incisions in the trunks of living trees, and partly by setting fire to billets of wood that have been channeled on one side, the resin as it fuses flowing out along the groove.

Description.—Tears, varying from ¼′ to 1′ in diameter, or irregular masses more or less intermixed with splinters of wood and particles of dirt. In thin pieces, transparent, lustre vitreous, fracture brittle and somewhat conchoidal, color greenish or reddish-brown, sp. gr. 1.2, fusing point about 180° F., soluble in alcohol and caustic potassa, but not in oil of turpentine or benzol. The freshly prepared powder is whitish, but soon turns green on exposure to the air, and its powder or solution is rapidly turned green by nitric acid and other powerful oxidizing agents.

Composition.—Complex, consisting of guaiacic acid, guaiac yellow, guaiaretic acid, guaiaconic acid, beta-resin, a small proportion of gum, ash, etc.

Properties.—Stimulant, diuretic and alterative.

Off. Prep.—Tinctura Guaicaci; Tinctura Guaiaci Ammoniata.

Copaiba Resin—Resina Copaiba, U. S.—Product of different species of Copaifera, natural order Leguminosæ.

Obtained from the oleo-resin by distilling off the volatile oil.

Description.—Amorphous, yellowish, or brownish-yellow brittle masses, soluble in alcohol, ether, carbon disulphide, benzol, and the volatile oils; odor similar to that of the oleo-resin; the alcoholic solution is somewhat acrid and bitter, and acid in its reaction.

Composition.—A mixture of copaivic and metacopaivic acids with more or less neutral resin.

Properties.—Same as those of the oleo-resin, which see.

Mastich—Mastiche, U. S.—Product of Pistacia Lentiscus, a small tree; natural order Terebinthaceæ, indigenous to the basin of the Mediterranean. Obtained from vertical incisions into the bast layer of the trunk and larger branches.

Description.—In rounded or elongated tears about the size of peas, brittle, with a conchoidal fracture, transparent when free from the powdery dust which usually adheres to them, of a light yellow color, partly soluble in alcohol, entirely so in ether and the volatile oils, the alcoholic solution acid in its reaction, odor faintly balsamic, taste somewhat terebinthinous, softening in the mouth, sp. gr. 1.07.

Constituents.—Masticlic acid, about 90%, soluble in alcohol; Masticin, soluble in hot alcohol; and a trace of volatile oil.

Uses.—Mild astringent and masticatory; also for varnishes and cements.

Off. Prep.—Pilulæ Aloes et Masticlies.

Elaterium.—Product of the squirting cucumber, Ecbalium Elaterium, natural order Cucurbitaceæ.

The resin is allowed to deposit from the expressed juice of the fruit, collected on linen or calico, and dried on tiles or between folds of bibulous paper.

Description.—In flattened pieces, greenish, grayish or yellowish in color, often more or less crystalline at the surface, light, of a granular fracture, odor faint, resembling tea, taste acrid, very bitter.

Constituents.—About 30 per cent. of Elaterin—Elaterium, U. S.—also Ecballin, hydro-elaterin, elaterid, and perhaps prophetin; but the elaterin is the substance on which the medicinal value depends.

Uses.—As an active hydragogue cathartic. Formerly officinal, but superseded by the neutral principle Elaterin in the U. S. P. '80.

Copal Resin.—Chiefly found fossil in Zanzibar and other parts of Africa, but is also obtained from various tropical leguminous trees.

Description.—Large irregular pieces, usually finely verrucose at the surface, hard, transparent or translucent, resembling amber, inodorous, tasteless, difficultly fusible, fracture conchoidal.

Constituents.—Several different resins.

Uses.—Chiefly for varnish.

Resins.—Oleoresins.

Dammar Resin, or Dammara.—Obtained from two different species of coniferous trees, Dammara Orientalis, East Indies; and Dammara Australis, New Zealand. It is a spontaneous exudation. The New Zealand Dammar sometimes occurs fossil.

Description.—Roundish, transparent, yellowish, inodorous, tasteless masses, that have a glossy, conchoidal fracture. It is not so hard as copal, melts at a temperature somewhat above 212° F., is somewhat soluble in alcohol, but more so in chloroform and benzol.,

Constituents.—Several different resins.

Uses.—Sometimes in the preparation of plasters, more commonly for varnishes.

Sandarac Resin, or Sandarae.—Spontaneous exudation from the stem of a small African tree, Callitris quadrivalvis, natural order Coniferæ.

Description.—Resembles mastiche, and is sometimes used to adulterate it. It differs in occurring in more elongated tears, in becoming powdered when masticated, and in being almost completely soluble in alcohol.

Constituents.—Three different resins and a bitter principle soluble in water.

Uses.—Chiefly for varnishes.

Colophony.—Resina, U. S.—Common Resin or Rosin.—Product of Pinus Australis, and of some other species of the same genus.

Obtained by the distillation of the crude turpentine or oleo-resin, the volatile oil distilling off, leaving behind the resin in the still. This, while still hot, is drawn off and passed through a series of strainers, when on cooling it constitutes the commercial resin. The color of the product varies according to the temperature at which the distillation takes place.

Description.—Transparent, light or dark amber colored masses, having a vitreous fracture, fusible at about 212° F., soluble in alcohol, ether, and in both volatile and fixed oils; odor and taste somewhat terebinthinate.

Constituents.—Chiefly abietic anhydride.

Uses.—Mainly for ointments and plasters.

Offi. Prep.—Ceratum Resinæ; Emplastrum Resinæ.

Shellac, or Lacca.—Product of a variety of East Indian and a few Mexican plants. An exudation produced by the puncture of a hemipterous insect, the female of Coccus laccа. The lac of commerce comes chiefly from India, and the most important trees which produce it appear to be a spurge, the Aleuritis laccifera, and a fig, the Ficus Indica.

Description.—It occurs in the following forms: *Stick lac* consists of the thin twigs of the tree covered with the resinous exudation. *Seed lac*, of the glossy fragments that have been detached from the twigs; and *Lump lac*, that obtained by boiling the stick or seed lac with water, and melting the product into cakes.

Shellac, of reddish or orange colored transparent flakes, brittle, tasteless and glossy, and produced in the same way as lump lac, only dried or hardened in thin plates instead of in masses.

Constituents.—Complex; five different resins, and some coloring and extractive matter.

Uses.—Chiefly in the preparation of varnishes and sealing-wax.

Amber, or Succinum.—Fossil product of an extinct coniferous tree, Pinitis succinifer, and probably also of other species.

Obtained principally from the shores of the Baltic, where it is cast up by the waves.

Description.—Hard, brittle, transparent, or translucent, yellowish or reddish-brown irregular masses; sp. gr. about 1.09; melts at 550° F., and at that temperature gives off succinic acid; irregular pieces, roughish or dull surface; frequently inclosing insects and fragments of wood or bark. Scarcely soluble at all in alcohol, ether, or the volatile oils, but somewhat soluble in chloroform.

Constituents.—Various resins and succinic acid.

Uses.—Source of oil of amber and succinic acid.

Official Preparation.—Oleum Succini.

Asphalt, or Asphaltum, like amber, is a fossil resin.

It is one of the series of petroleum products, and forms extensive deposits in some parts of the world, as in the Island of Trinidad. Used in manufacture of varnishes.

The Oleo-Resins.

The Oleo-resins, like the resins, are of vegetable origin, and consist of mixtures in various proportions of *resins* with *volatile oils*. They therefore partake of the characters of both.

COPAIBA.

Copaiba—Copaiba, U. S.—Commonly called Balsam of Copaiva. Obtained from trees of the different species of Copaifera, by boring holes into the heartwood, the oleo-resin being contained in ducts, frequently of large size, in the interior of the trunk.

Description.—Light yellow or brownish yellow, transparent or somewhat turbid, viscid liquid, with a peculiar aromatic odor and an acrid, bitter, and nauseous taste. Sp. gr. of from .94 to .99; density increasing with age; soluble in strong alcohol, benzol, and carbon disulphide; insoluble in water.

The principal kinds of Copaiba are:

Para Copaiva, limpid, light-colored and transparent, and contains from 70 to 85 per cent. of volatile oil.

Rio Janeiro and *Maranham Copaiva* resemble each other closely; denser than the Para; usually contain from 50 to 60 per cent. of volatile oil.

Maracaibo Copaiva, still denser, deeper colored, often somewhat turbid; does not usually, like the other Copaivas, yield a clear mixture with one-third its weight of ammonia water; contains only from 20 to 40 per cent. of volatile oil, and solidifies with magnesia.

Adulterations.—Castor and other fixed oils, turpentine and other volatile oils, and other oleo-resins, as Gurjun balsam. Fixed oils are detected by the sticky residue left behind on evaporating the volatile oil, by the greasy areola left around the resin when a drop of the suspected article has its volatile oil evaporated from paper, and by the fact that most fixed oils are insoluble in alcohol. Volatile oils, are recognized usually by their odor when warmed.

Gurjun balsam, castor oil, linseed oil, and Venice turpentine are detected by agitating one volume of the suspected article with ten of petroleum benzin. If either of these substances be present, the mixture will have a milky appearance, and will on standing separate into two layers.

Constituents.—Volatile oil; copaivic, oxycopaivic, or metacopaivic acids; various resins, and a bitter principle soluble in water.

Uses.—Expectorant, diuretic and stimulant. Also applied externally.

Official Preparation.—Massa Copaibæ.

Oleoresins.

Gurjun Oleo-Resin, commonly called Gurjun Balsam.—Product of Dipterocarpus turbinatus, and other species of the same genus of trees, indigenous to India and the Malay Archipelago.

Obtained by making deep incisions in the trunk, and then charring it, causing the oleo-resin to flow freely.

Description.—Closely resembles the more viscid forms of Copaiva in odor, but to the taste is more bitter and not acrid. When heated to a temperature of about 266° F., it becomes gelatinous, and does not resume its fluidity on cooling. Sp. gr. from .95 to .96, entirely soluble in carbon disulphide, chloroform, and the volatile oils, but only partially so in alcohol, ether, and petroleum benzin.

Constituents.—Gurjunic acid, resins and volatile oil.

Uses.—Similar to those of Copaiva.

The Turpentines.

Several turpentines are used in pharmacy, and all but one of them, Cyprus turpentine, are the product of trees belonging to the natural order Coniferæ. Cyprus turpentine is the product of one of the Anacardiacæ.

The volatile oils in all of them are identical in chemical structure, though differing somewhat in odor. Their chemical formula when pure is $C_{10}H_{16}$.

Common Turpentine.—Terebinthina, U. S. Commonly called "gum" or "pitch" turpentine. Exudation from various species of American pines, particularly from Pinus Australis.

Description.—Semi-fluid oleo resin, composed of a volatile oil (oil of turpentine) and two resins, one fusing at 212° F. and the other at 293° F.

Uses.—Diaphoretic, diuretic, stimulant and astringent. Used externally in ointments and plasters. Its principal use is in the preparation of "turpentine" oil, which is obtained by distillation, the residue being "rosin."

Canada Turpentine.—Terebinthina Canadensis, U. S. Liquid or semi-liquid oleo-resin. Exudes from the Balsam Fir, Abies balsamea, and also from Abies Fraseri.

Description.—Transparent when pure, slightly yellowish or greenish, viscid, odor and taste similar to common turpentine, but more agreeable, with age hardening, and acquiring a distinct yellow color.

Composition.—Volatile oil and two resins, one readily soluble in alcohol, the other with difficulty.

Uses.—Stimulant, diaphoretic, diuretic. Mostly used externally. Used extensively as a mounting medium in microscopy.

Venice Turpentine.—Terebinthina Veneta. Product of the European larch, Larix Europæa. Secreted in the heart-wood, and is obtained by boring holes to the center of the tree and dipping the liquid out as it accumulates.

Description.—Dense, nearly colorless, transparent, fluorescent liquid of a terebinthinate odor and an aromatic, acrid, and bitter taste.

Composition.—Volatile oil, two or more resins, and succinic acid. Completely soluble in alcohol.

Uses.—Stimulant, diuretic, and diaphoretic. Also used externally in ointments and plasters.

Strassburg Turpentine.—Terebinthina Argentoratensis. Product of Abies pectinata.

Resembles Canada Balsam in its composition, properties and uses. Odor more agreeable. Contains a small amount of succinic acid.

Burgundy Pitch.—Pix Burgundica, U. S. Exudation product of Abies excelsa, or Norway Spruce Fir, a native of Central and Northern Europe.

Description.—Hard, but yielding without fracture to slowly graduated pressure, semi-transparent or opaque, yellowish or brownish; fracture shining, conchoidal; odor aromatic; taste agreeable.

Composition.—Volatile oil, probably $C_{10}H_{16}$, resin, and a little water.

Uses.—For ointments and plasters.

Officinal Preparations.—Emplastrum Picis Burgundicæ; Emplastrum Picis cum Cantharides.

Hemlock Pitch.—Pix Canadensis, U. S. Product of common Hemlock, Abies Canadensis.

Dark reddish brown in color, with a weak terebinthinate, balsamic odor, and resembles in its composition, properties and uses, Burgundy pitch.

Off. Prep.—Emplastrum Picis Canadense.

Cyprian or Chian Turpentine.—Terebinthina Chia. Product of Pistacia terebinthus, natural order Anacardiaceæ. Obtained from incisions in the bark of the tree.

Description.—Transparent or nearly so, semi-fluid or hardened, brownish or greenish-yellow in color, taste somewhat bitter, odor balsamic, somewhat fennel-like.

Composition.—Volatile oil and two resins, one soluble in cold alcohol, the other insoluble.

Uses.—Similar to those of other turpentines.

Elemi.—There are several varieties.

Manila Elemi, probably an exudation from Canarium commune, natural order Burseraceæ.

Brazilian Elemi, from Icica Icicariba and other species of the same genius.

Mexican Elemi, supposed to be the product of Amyris elemifera; and

Mauritius Elemi, from Colophonia Mauritiana.

The first; Manila Elemi, is the most important.

Description.—Crystalline, yellowish, soft, friable when old; taste pungent, disagreeable, bitter; odor aromatic, balsamic.

Composition.—Volatile oil ($C_{10}H_{16}$), elemic acid, crystalline resins, and amorphous resins.

Uses.—Stimulant and irritant; externally in ointment and plasters.

Tar.—Pix Liquida, U. S. Products of the destructive distillation of the wood of various species of pine. Mainly produced in North Carolina.

Description.—Blackish-brown, thick semi-fluid, becoming granular from the formation of crystals when old; odor empyreumatic and terebinthinate; taste bitter, empyreumatic, and somewhat acrid; soluble in alcohol, solution of caustic potash, the volatile oils, and sparingly so in water.

Composition.—Very complex and somewhat variable. Among the lighter products are acetic acid, acetone, methyl alcohol, toluol, xylol, cumol, and methol; and among the heavier, pyrene, chrysene, naphthalin, paraffin, phenol, creasote, resin, etc.

Uses.—Stimulant and irritant. Given internally, and used also externally in ointments and plasters, and for fumigations.

Officinal Preparations.—Syrupus Picis Liquidæ; Unguentum Picis Liquidæ.

Balsams.—Gum Resins.

THE BALSAMS.

The term balsam is used very frequently in a loose, general sense to designate certain resins, oleo-resins, and mixtures of various kinds, differing widely in composition and properties, but supposed to possess healing virtues.

The term is here restricted to those liquid, semi-liquid, or solid vegetable products that contain, in addition to a resin or oleo-resin, benzoic or cinnamic acids, or both.

Tolu.—Balsamum Tolutanum, U. S. Product of a Leguminous tree, Myroxylon Toluifera, a native of Central America, Venezuela, and New Granada.

Description.—Liquid or semi-liquid when fresh, hardening with age, but still readily softening in the mouth, yellowish or reddish-brown in color, in thin layers transparent; when examined microscopically, showing crystals of cinnamic acid; odor agreeably aromatic, somewhat resembling vanilla; taste aromatic; completely soluble in alcohol and ether, but insoluble in carbon disulphide and petroleum benzin.

Composition.—Benzoic and cinnamic acids, two resins differing in their solubility in alcohol, toluene, and benzylic benzoate and cinnamate.

Adulterations.—Turpentines, which may be detected by means of sulphuric acid, which turns pure tolu balsam a cherry red, but bleaches that which contains turpentine.

Uses.—Expectorant, stimulant. Used by perfumers, and in the manufacture of pastiles.

Off. Prep.—Syrupus Tolutanus; Tinctura Tolutana.

Peru Balsam.—Balsamum Peruvianum, U. S. Derived from another species of the same genus, Myroxylon Pereiræ, a tree growing in West Brazil, Northwestern coast of South America, and Central America.

Description.—Molasses-colored, semi-liquid, red-brown, and transparent when seen in thin layers; sp. gr. about 1.4; odor agreeable, aromatic, somewhat smoky; taste, warm, bitterish, afterward acrid.

Composition.—Benzoic and cinnamic acids, benzylic benzoate and cinnamate, benzylic alcohol and resin.

Adulterations.—Alcohol, fixed oils, copaiva, turpentine, rosin, etc. (For tests of purity see U. S. P.)

Uses.—Externally as ointment, internally, stimulant and expectorant.

Storax Balsam.—Styrax, U. S. Product of the Liquidamber Orientalis, natural order Hamamelaceæ, inhabiting the Southwestern part of Asia Minor. Extracted from the inner bark of the tree by boiling in water.

Description.—Consistency of thick syrup; opaque from containing finely divided particles of water; separated by standing into two layers, one heavier and darker colored, the other lighter and containing most of the water; odor strong, agreeable, balsamic. Soluble in alcohol, ether, and carbon disulphide, insoluble in cold petroleum benzin, but hot benzin dissolves out the styracin and cinnamic acids which are deposited in crystals on cooling.

Composition.—Benzoic and cinnamic acids, styracin, storesin, resins, etc.

Uses.—Stimulant, diuretic, or expectorant; also in Tinctura Benzoini Compositæ.

Liquidamber styraciflua, the Sweet Gum tree of the Southern United States, exudes a similar balsam. It is usually solid.

Dragon's Blood.—Resina Draconis. Exudation from ripening fruit of Dæmonorops Draco, a species of palm, native to the Malay Archipelago.

Description.—Solid, dark, red-brown, in tears, rounded masses, sticks, or irregular cakes, transparent in thin pieces, aromatic, and with a benzoin-like odor when heated; readily soluble in alcohol, benzol and turpentine.

Composition.—Resins, benzoic or cinnamic acid. Sometimes the one and sometimes the other acid is present, and sometimes both are wanting.

Uses.—Astringent, stimulant. Employed for coloring varnishes and tinctures, and in plasters.

Benzoin.—Benzoinum, U. S. A solid balsam from Styrax Benzoin, a tree native to Sumatra, Java, and Siam. Exudes from incisions made through bark of tree.

Description.—Several varieties, the better consisting of opaque, milk-white tears, agglutinated in masses, the mass being yellowish or grayish-brown; but inferior kinds contain few tears, and a large proportion of bark and chips of wood.

Sumatra Benzoin, in brown-gray masses, containing a variable proportion of milky-colored tears.

Siam Benzoin, in red-brown translucent masses, with few or many tears, and an agreeable vanilla-like odor.

Penang Benzoin, sometimes very similar to the Sumatra variety, but at other times more resembling storax in appearance and odor.

Composition.—Benzoic and cinnamic acids, various resins, and, in some varieties, vanillin.

Uses.—Stimulant, expectorant. Also in preparation of pastiles, dentifrices and perfumes.

Officinal Preparations.—Adeps Benzoinatus; Tinctura Benzoini; Tinctura Benzoini Composita.

THE GUM RESINS.

The Gum Resins include those milky exudations of plants which contain a gum soluble in water, and a resin insoluble in water, but soluble in alcohol. They also often, but not always, contain volatile oils. They may, therefore, be conveniently divided into two groups:

(1) Those which contain volatile oil:

Myrrh, Bdellium, Olibanum, Galbanum, Asafœtida, Sagapenum, Ammoniac, Opoponax.

(2) Those which do not contain volatile oil:

Gamboge, Scammony, Euphorbium.

Myrrh.—Myrrha, U. S. Spontaneous exudation from bark of Balsamodendron Myrrha, natural order Burseraceæ, a tree inhabiting Arabia and Northeastern Africa.

Description.—Dusty, reddish or yellowish-brown masses or irregular tears; odor aromatic; taste, bitter, acrid.

Composition.—Gum 40.60 per cent., resin 25.40 per cent., volatile oil, bitter prineiple, and ash.

Uses.—Given internally and applied externally. Stimulant, expectorant, emmenagogue.

Off. Prep.—Mistura Ferri composita; Pilulæ Aloes et Myrrhæ; Pilulæ Ferri compositæ; Tinctura Aloes et Myrrhæ; Tinctura Myrrhæ.

Bdellium.—Similar to myrrh. Product of another tree of the same genus, Balsamodendron Mukul, a native of East India and West Africa.

It is best distinguished from myrrh by testing the tincture with nitric acid. Myrrh acquires a purple hue, while bdellium does not. Used mostly in plasters.

Gum Resins.

Olibanum, or Frankincense. Exudes from incisions made in bark of Boswellia Carterii and other species of the same genus, Nat. Ord. Burseraceæ. The trees are natives of Arabia and Eastern Africa.

Description.—Light red or yellowish, translucent, externally dusty tears of variable size and shape. They soften when held in the mouth, have a bitterish and balsamic taste, and a balsamic odor. Lump olibanum is less pure, being gathered from the ground.

Composition.—Gum about 30 per cent., resin 60 to 70 per cent., volatile oil, and a bitter principle.

Uses.—Chiefly for plasters and fumigations; sometimes internally. Expectorant, tonic, stimulant.

Galbanum.—Galbanum, U. S. Spontaneous exudation from stem of Ferula galbaniflua, and other species of the same genus of Umbelliferous plants. There are two kinds; in tears, and lump galbanum.

Description.—The tears are small, from the size of a pin-head to that of a pea, or larger, mostly agglutinated into a hard mass. Yellowish-brown or greenish brown outside, whitish or yellowish inside, peculiar balsamic odor, acrid bitterish taste. Treated with alcohol and then with chlorhydric acid, it turns purplish.

Lump galbanum sometimes incloses tears, is sometimes soft, has a somewhat different color, and does not change color by alcohol and chlorhydric acid. Probably derived from a different species of plant.

Composition.—Gum 15 to 20 per cent., resin 60 to 66 per cent., volatile oil 6 to 9 per cent.

Uses.—Antispasmodic, stimulant, expectorant.

Official Preparations.—Emplastrum Asafœtidæ, Emplastrum Galbani; Pilulæ Galbani compositæ.

Asafœtida.—Asafœtida, U. S. Exudation product from two different species of Ferula, F. narthex and F. scorodosma. The former is a native of Thibet and Cashmir, the latter of Afghanistan and Turkestan. Obtained by making incisions in the root.

It occurs in the following varieties:

Asafœtida in tears. These may be nearly distinct, or more or less agglutinated in masses.

Amygdaloid asafœtida. Irregular pieces made up of tears imbedded in a sticky yellowish or brownish gray mass. Tears, when the mass is freshly broken, white, but on exposure changing to pink and then to brown. More or less impure from vegetable fragments and earthy matters.

Liquid asafœtida is a sticky semifluid, more or less impure mass at first, light colored, but gradually turning brown on exposure.

Stony asafœtida is a very impure variety, consisting of a little of the gum-resin mixed with a large proportion of calcium sulphate and other impurities.

Good asafœtida should contain 60 per cent. of matter that is soluble in alcohol; it has a strong alliaceous odor, and bitter, acrid taste; forms a milky emulsion with water, and when moistened with alcohol and afterward with chlorhydric acid, a greenish color is produced.

Composition.—Gum 20 to 30 per cent., resin 50 to 70 per cent., 3 to 9 per cent. volatile oil, and various impurities.

Uses.—Stimulant, antispasmodic, expectorant, laxative.

Official Preparations.—Empl. Asafœtida; Mistura Asafœtidæ; Pil. Aloes et Asafœtidæ; Pil. Asafœtidæ; Pil. Galbani comp.; Tinctura Asafœtidæ.

Ammoniac.—Ammoniacum, U. S. Spontaneous exudation product from stem of Dorema ammoniacum, Nat. Ord. Umbelliferæ.

Description.—Distinct or agglutinated tears, light yellowish-brown externally, milk-white internally, softens by the heat of the hand; has a bitter and disagreeable acrid taste, and is not colored when treated with alcohol and then with chlorhydric acid.

A form which comes in cakes, and consists of tears imbedded in a brown mass; is too impure for medicinal use.

Composition.—Gum 18 to 28 per cent., resin about 70 per cent., volatile oil from ½ to 4 per cent.

Uses.—Expectorant and stimulant.

Official Preparations.—Empl. Ammoniaci; Empl. Ammoniac c. Hydrarg.; Mistura Ammoniaci.

Opoponax gum-resin. Product of another umbelliferous plant, a native of Southern Europe, the Opoponax Chironium. Obtained by making incisions in root or lower part of stem.

Description.—Irregular masses, angular or rounded, ⅛ inch to 1 inch or more in diameter, friable, reddish or yellowish brown, odor disagreeable, taste balsamic, bitter. Similar in properties and uses to ammoniac.

Gamboge.—Gambogia, U. S. Obtained by making incisions into the bark of Garcinia Hanburii, Nat. Ord. Guttiferæ, a small tree native to Cochin China, Cambodia and Siam.

Description.—In sticks or cakes, the former preferred on account of its being less liable to adulteration. Sticks cylindrical, sometimes hollow; surface striated from the impressions of the bamboo, in the hollow stems of which the gum resin is collected; fracture smooth, conchoidal, orange red in color, inodorous, taste unpleasant acrid, dust sternutatory. A good quality yields a bright yellow powder, and also a bright yellow emulsion when triturated with water.

Composition.—Gum 16 to 20 per cent., and resin about 80 per cent., besides some water and impurities.

Uses.—In combination with other medicine as a hydragogue cathartic.

Official Preparations.—Pilulæ Catharticæ compositæ.

Euphorbium.—Exudation from incisions in the stem of Euphorbia resinifera, a cactus-like shrub, native to the mountain slopes of Morocco.

Description.—Dull brownish yellow, somewhat translucent, globular, conical or irregular masses, dust violently sternutatory, taste very acrid. Not completely soluble in any simple solvent; does not completely emulsify in water.

Composition.—Gum 18 per cent., euphorbion and another resin, malates, and various impurities.

Uses.—Externally as rubefacient, vesicant and suppurant. If taken internally it acts as a violent and dangerous purgative and emetic.

Scammony.—Scammonium, U. S. Dried milk-juice of Convolvulus Scammonia, Nat. Ord. Convolvulaceæ, a native of Western Asia. Obtained by cutting off the top of root and scraping away the exuding milk-juice.

Description.—Dark greenish or blackish irregular masses, or regular cakes, breaking with an angular fracture, and a resinous lustre, powdered it possesses a greenish cast, and yields with water a dark greenish emulsion; odor somewhat like cheese, taste acrid.

Composition.—Gum 5 to 15 per cent., resin 80 to 90 per cent., and various impurities Liable to be adulterated with starch, chalk, and with various resins.

Uses.—As hydragogue cathartic.

Official Preparation.—Resinæ Scammonii.

The Fatty Oil Group.

The Fatty Oils constitute a very distinct natural group of ternary compounds, and are found widely distributed in both the animal and vegetable kingdoms, few animals or plants being entirely destitute of them.

In the higher animals they are mainly stored beneath the skin in the connective tissue, in the abdominal cavity about the kidneys, etc. In plants they often constitute a considerable portion of the weight of seeds and fruits, but they are found not infrequently stored in smaller quantities in other parts of the plant. In both kingdoms they serve mainly as reserve stores of food.

They are sometimes liquid, sometimes semi-liquid, sometimes solid at ordinary temperatures; they are greasy to the feel when sufficiently fluid, impart a greasy stain to paper that *does not volatilize by heat*, are lighter than water, and do not mingle with it in any proportion, are usually but *slightly soluble in alcohol*, while they are *freely soluble in ether*, carbon disulphide, and petroleum benzin; they are *not volatilizable without chemical change*, but at a temperature varying between 500° and 600° F. boil, giving off irritating vapors, and most of them, when treated with alkali, *form soaps*, the soaps made with potassa being softer than those made with soda.

The fixed oils are all *combustible*, burning with a smoky flame. Some remain unchanged for a long time when exposed to the air, while others, especially those that contain mucilaginous or proteid impurities, undergo change and become rancid, while still others gradually harden, lose their unctuous feel, and are converted into tough, flexible solids. These last are called *drying oils*.

Chemically considered, the fixed oils are mixtures, in various proportions, of two or more compounds. The most important of these are:

Olein, Stearin, Palmitin, Myristin, Laurin.

Also many others of minor importance.

These are regarded as *ethereal salts*. For the most part they are compounds of glycerin (a triatomic alcohol), with acids of the oleic and fatty acid series, and, on saponification, yield glycerin; but some of them, when saponified, yield, instead of glycerin, some of the higher or more complex monatomic alcohols. To this class belong the *waxes*.

ADULTERATIONS.

These are chiefly mixtures of the rarer and more expensive kinds with common and cheaper ones, and on account of the resemblance in composition, the fraud is difficult to detect.

The principal means of detection are by the *odor* when warmed, and by the *specific gravity*.

There are a few oils that are nearly odorless, but for the most part they have a more or less characteristic odor, which, by carefully comparing a sample of a suspected product with one of known purity, would enable one to detect the presence of impurities. As the fixed oils do not differ widely in their densities, the specific gravity test must be carefully applied.

As most oils are but slightly soluble in alcohol, while a few are freely soluble in that medium, this fact is applicable in some cases as a test of purity.

The determination of *the boiling point* is also serviceable in some cases, particularly in determining whether or not there has been an admixture of volatile oils.

The presence of *fish oil* as an adulterant of any of the vegetable oils, may readily be detected by passing a current of chlorine gas through the oil. If it be pure, no change of color will take place, but if fish oil has been used as an adulterant, the mixture will turn dark.

Another test applicable in a few cases is the *sulphuric acid test*. If ten parts of the oil be heated with one of sulphuric acid, different colorations will be produced, which will depend upon the nature of the oil. For instance, oil of black mustard will be changed to a bluish green, linseed oil will turn dark brown, and fish oil will assume a reddish color.

THE PREPARATION OF OILS.

In the case of animal fats, they are separated from other tissues usually by heating them to their melting-point or a little above, either alone or in the presence of water, and separating them from the other tissues by straining.

The fixed oils from vegetable structures are usually separated from the containing tissues by *pressure*, applied by means of a suitable press.

The tissues are usually ground or crushed, and then pressed, either cold or between metallic surfaces heated to a temperature a little above that of the melting point of the oil. Sometimes, however, the oil is separated by boiling the tissues in the presence of water, and separating the refuse solid matter by straining. The product obtained by this last process is generally inferior to that obtained by pressure alone.

PURIFICATION AND PRESERVATION.

As has been stated above, the presence of mucilaginous and proteid compounds in oils tends to produce rancidity; it is, therefore, desirable to get rid of these impurities.

This is done either by filtration or by the introduction of some reagent that destroys the impurities. When the quantity to be purified is small, the filtration process is generally resorted to. Care should be taken in this process that the filter be perfectly dry, or the water-bath filter may be used.

When the quantity is considerable, *sulphuric acid* is gradually added to the amount of from 1 to 2%. This carbonizes the impurities, and after separating the acid by repeated agitation with water, the carbonized impurities are gotten rid of by filtration.

As many fixed oils undergo gradual change, even if pure, when exposed to the light and air, they should be kept in closed vessels; also, as these changes occur more rapidly at an elevated than at a low temperature, they should be kept in a *cool* place.

The Fixed Oils may be classified as follows:

I. Those which contain glycerin—

(1) Liquid fats.

a. Drying Oils. } Vegetable.
b. Non-Drying Oils. } Animal.
c. Oils partaking partly of the characters of both. } Fish Oils. Cotton Seed Oil Group. Castor Oil Group.

(2) Solid Fats.

a. Those containing Volatile Oil (odorous).
b. Those not containing Volatile Oil (non-odorous).

II. Those which contain no glycerin, including the waxes.

These groups will be considered in their order.

Liquid Fats.

Liquid Fats.

Under Liquid Fats are included those which are liquid at ordinary temperatures, but many of these become solid or partly so at a low temperature. Usually by reducing the temperature one of the constituent oils solidifies before the others, and hence often by this means it may be separated.

The Drying Oils.

These are all derived from the vegetable kingdom and are distinguished from other oils by the fact that by exposure to the air they are gradually converted into tough, flexible masses. They are not solidified by nitrous acid.

The most important members of the group are:

Flaxseed Oil.—Oleum Lini, U. S. Obtained by pressure from seeds of Linum usitatissimum.

Color, yellow, or if obtained by hot pressure, darker. *Odor,* slight. *Taste,* bland. *Sp. gr.* .936. *Solidifies* at 16.5° F. *Composed* of palmitin, myristin, and linolein, mainly. *Uses,* as demulcent; externally, as protective.

Oil of Hemp.—Oleum Cannabis. Obtained by pressure from crushed fruit of Cannabis sativa.

Color, green, changing to light brown on exposure. *Odor,* disagreeable. *Taste,* mild. *Sp. gr.* .930. *Solidifies* at about 5° F. *Composed* of palmitin, linolein, and possibly other oils. *Uses,* as demulcent and protective.

Nut Oil.—Oleum Juglandis. Obtained by pressure from the seeds of various species of Juglans.

Color, greenish or none. *Odor,* faint. *Taste,* bland, nut-like. *Sp. gr.* .92. *Solidifies* at about 0° F. *Contains* probably linolein with other fixed oils; but no analysis has been made. *Uses,* as a demulcent and protective.

Poppy-Seed Oil.—Oleum Papaveris. Obtained by pressure from the crushed seeds of Papaver somniferum.

Color, light yellow. *Odor,* slight. *Taste,* bland. *Sp. gr.* .92. *Solidifies* at 0° F. *Contains* linolein, palmitin, and probably other fixed oils, *Uses,* protective, demulcent.

The Non-Drying Oils.

These oils do not *solidify* on exposure to the air. They are also characterized by the fact that they become *solidified* when treated with *nitrous acid.* As a group also they are less *fluid* than the drying oils.

They may be subdivided into two kinds: those of *vegetable* and those of *animal* origin.

To the former belong:

Olive,	Almond,	Colza,
Mustard,	Rape,	Earth-nut.

And to the latter:

Neatsfoot, Lard, Tallow and Bone Oil.

The most important of the first kind are:

Olive Oil.—Oleum Olivæ, U. S. Obtained from the fruit of Olea Europæa; the best quality, or virgin oil, by cold pressure of crushed fruit; a second quality, by mixing the cake that is left with hot water, and again expressing; and a third, very inferior and more or less rancid oil, from decayed residue.

Color, yellow or greenish yellow. *Odor,* faint, agreeable. *Taste,* bland. *Sp. gr.* .918. *Solidifying* completely only at very low temperatures, but depositing crystals at 41° F. *Contains* chiefly olein, also small quantities of palmitin, cholesterin, arachin, and probably stearin. *Uses,* as lenitive.

Officinal Preparations. — Emplastrum Plumbi; Unguentum Diachylon.

Oil of Almond.—Oleum Amygdalæ Expressum, U. S. Obtained from the crushed seeds of Amygdalus communus var. amara, by powerful pressure, previous to their treatment for obtaining the oil of bitter almond. May also be obtained in same way from the seeds of the sweet almond.

Color, yellowish. *Odor,* faint, nutty. *Taste,* bland. *Sp. gr.* .92, *Solidifies* at about 4° F. *Contains* olein and a little palmitin. Oils expressed from peach and apricot kernels resemble almond oil, but when the latter is mixed with an equal bulk of nitric acid, sp. gr. 1.16, and heated to 140° F., it does not turn yellow or orange, while the oils from peach and apricot, treated in the same way, do. *Uses,* as lenitive and demulcent.

Officinal Preparation. Unguentum Aquæ Rosæ.

The most important animal non-drying oils are:

Neatsfoot Oil.—Oleum Bubulum. Obtained by boiling with water the fatty tissue of neatsfeet and straining.

Little odor or taste. *Sp. gr.* .915. Solid fats begin to separate at 32° F. *Contains* olein and solid fatty bodies. *Uses,* mostly externally.

Lard Oil.—Oleum Adipis, U. S. Obtained from lard, by exposing it to a low temperature and then subjecting it to great pressure.

Color, yellowish or almost none. Nearly odorless and tasteless. *Contains* olein, with some stearin and palmitin. *Uses,* only externally.

Intermediate Oils.

Oils partaking partly of the characters of both Drying and Non-Drying Oils.

This is a miscellaneous group, composing oils both of animal and vegetable origin, most of which thicken but *do not solidify* on exposure.

They agree in becoming more or less thickened, but in *not solidifying* when treated with *nitrous acid.*

They are divisible into three distinct sub-groups, as follows:

(1) The Fish Oils; (2) the Cotton-Seed Oil group; (3) the Castor Oil group.

The Fish Oils include:

Cod Oil,	Cod Liver Oil,	Hake Oil.
Sperm Oil,	Porpoise Oil,	Shark Oil,

and various others.

For the most part they change their consistency but little on prolonged exposure to the air; they turn *brown* on exposure to *chlorine* gas; are *reddened* by boiling with caustic *alkali;* are but *little thickened* on treatment with *nitrous acid,* and have a more or less disagreeable *fishy odor.*

Cod Liver Oil.—Oleum Morrhuæ, U. S. Obtained by slowly heating in the presence of water the livers of Gadus Morrhua and other species of the same genus, and decanting the oil from the water.

Color, light yellow. *Odor,* fishy. *Taste,* disagreeable. *Sp. gr.* .92. Deposits crystalline matter at about 32° F. *Contains* olein, palmitin, stearin, and minute quantities of iodine, bromine, biliary compounds, etc. *Uses,* Alterative, demulcent, nutritive. The inferior oils are amber-colored or brownish, of a more disagreeable odor and taste, and they deposit crystalline matter at a temperature higher than 32° F.

The remaining oils of this group are of but little value in pharmacy; they are chiefly employed as lubricating media.

Oils—Soaps.

The Cotton-seed Oil group include:

Cotton-seed Oil, Sesami Oil,
Beech-nut Oil, Sunflower Oil,

and some others.

Their *viscosity* is considerably increased by exposure to the air; they are considerably *thickened* by the action of *nitrous acid*, and they are mostly bland to the taste, and nearly odorless.

Cotton-Seed Oil.—Oleum Gossypii Seminus, U. S. Obtained by pressure from the crushed seeds of Gossypium herbaceum. The crude brownish oil is treated with boiling water, and afterward with a little alkali to bleach and purify it.

Color, yellowish. *Odor*, slight. *Taste*, sweetish, similar to that of almond oil. *Sp. gr.* .92 to .93. *Solidifies* at 32° F., or a little below. *Contains* olein, palmitin, and yellow coloring matter. *Uses*, as a demulcent.
Preparations.—Most of the officinal liniments.

Benne Oil.—Oleum Sesami, U. S. Obtained by pressure from the crushed seeds of Sesamum Indicum.

Color, transparent, yellow. *Odor*, little or none. *Taste*, bland. *Sp. gr.* .92. *Solidifies* at about 23° F., or a little below. *Contains* olein, palmitin, stearin, and myristin. *Uses*, as a demulcent. *Test*, turns red-brown when treated with a mixture of cold nitric and sulphuric acids.

The remaining oils of this group, in common with other oils possessing similar properties, such as the oil of the pea-nut, etc., are used for domestic and culinary purposes. Their employment in pharmacy, however, is comparatively rare.

The Castor Oil group include:

Castor Oil and Croton Oil.

They are somewhat denser and more *viscid* than the members of the preceding sub-group, behave similarly to them as regards exposure to the air and nitrous acid, but differ from all the other oils in being *freely soluble in alcohol*, and in possessing strongly *purgative* properties.

Castor Oil.—Oleum Ricini, U. S. Obtained from the dried and crushed seeds of Ricinis communis. That obtained by *cold* pressure is the best. It is purified by agitating with warm water, and decanting the oil.

Color, none. *Odor*, slight. *Taste*, nauseous, slightly acrid. *Sp. gr.* .96. *Solidifies* at about 0° F. *Soluble* in an equal weight of strong alcohol. *Consists* of ricinolein, palmitin, and an acrid principle. *Uses*, as a purgative.

Croton Oil.—Oleum Tiglii, U. S. Obtained by pressure from the crushed seeds of Croton Tiglium. Sometimes also obtained by treating crushed seeds with carbon disulphide and evaporating solvent.

Color, yellowish or brownish. *Odor*, slight, peculiar. *Taste*, very acrid. *Sp. gr.* .95. *Soluble* when fresh in about sixty parts of alcohol, but its solubility increases with age. *Contains* palmitin, stearin, laurin, myristin, various odorous oils, as glycerides of valerianic and butyric acids; and also tiglinic acid and crotonol. *Uses*, as an irritant, rubefacient, and sometime internally as a drastic purgative.

SOAPS.

When fats or oils are mixed with salifiable bases, the three principles which they contain, viz.: Olein, palmitin and stearin, are decomposed into their respective acids, *oleic*, *palmitic* and *stearic* acids, which unite with the base forming *soap*.

Fats, being mostly compounds of glycerin with one or more of these acids, are split up, when boiled with the base, by the reaction into *salts*, and *glycerin*, which not being saponifiable, is set free.

Soaps are therefore *chemical salts*, and consist of *oleates*, *palmitates* and *stearates*, according to the proportion of these in the fats.

Soaps may be divided into two classes:

(1) Soluble soaps. (2) Insoluble soaps.

Soluble Soaps comprise those made with soda and potassa, and are respectively termed *hard* and *soft* soap. They are both made with olive oil, and the former, Castile soap, constitutes the base of nearly all the finer soaps used for the toilet and bath. It is officinal under the name of:

Sapo, U. S.—When dried to a constant weight at a temperature of 110° C., it should not lose more than 34 per cent. of its weight (water).

Officinal Preparations.—Emplastrum Saponis; Linimentum Saponis.

Green Soap.—Sapo viridis, U. S. Is a soft soap prepared from olive oil and potassa. It is used in ointments; also in

Officinal Preparation.—Tinctura Saponis viridis.

Insoluble Soaps or oleates, as they are also termed, are formed by combining the fat acid with an *earth* or *metallic oxide*, *i. e.*, alumina; lead.

They are usually prepared by *double* decomposition between a soluble soap and a solution of the salt of the metal in water.

The following process will illustrate their preparation:

Zinc oleate or oleo-palmitate.

	Parts.		Parts.
Zinc sulphate	1	Soap (white)	2
Water dist.	10	Water	10

Dissolve the zinc sulphate in the water and filter the liquid. The soap is sliced and dissolved in the water upon a water-bath, and then strained. The zinc solution is added very slowly to the solution of soap under constant stirring, until it ceases to produce a precipitate. Upon cooling, the insoluble soap will form a crust on the surface of the clear liquid which contains sodium sulphate in solution. The soap is broken up, dried and powdered.

It is a mixture of oleates and palmitates, the proportion of these depending of course upon the relative proportion in the soap or oil from which it was made.

Insoluble soaps are prepared in the same manner from the various salts, as for example: lead oleate, from lead acetate by the above process, instead of the much more tedious one by boiling oil, litharge and water; but in this latter it must be remembered that glycerin remains in the liquid. In preparing lead plaster (oleate of lead) from soap, no glycerin is obtained, because, as before stated, the glycerin is set *free* in the making of the soap, and is usually wasted.

Fats—Waxes—Petrolatum.

THE SOLID FATS.

Under these are included all those compounds of glycerin which remain *solid* at ordinary temperatures. Their melting points are more or less variable, and may, under certain conditions, be permanently altered. Some are of *vegetable* and others of *animal* origin.

To the *first* group belong those which contain a volatile oil. The most important are:

Expressed Oil of Nutmeg.—Oleum Myristicæ Expressum. Obtained by hot pressure from the seeds of Myristica fragrans and other species of the same genus.

Color, yellowish or whitish, mottled with orange-brown. *Odor*, aromatic. *Taste*, spicy. *Sp. gr.* .995. *Melts* at about 113° F. *Soluble* in four times its weight of strong alcohol. *Contains*, besides volatile oil, myristicin, myristic acid, and coloring matter. *Uses*, stimulant, carminative

Laurel Oil.—Oleum Lauri. Obtained by steeping the fruit of Lauris nobilis in hot water and subjecting it to hot pressure.

Color, greenish. *Consistency* of butter, granular. *Odor* and *taste*, aromatic, spicy. *Melts* at about 105° F. *Uses*, in ointment, etc. Stimulant and nervine.

The *second* group of the solid fats contain no volatile oil, but an odorous principle. Some are of vegetable, others are of animal origin.

The most important are the following:

Palm Oil.—Oleum Palmæ. Obtained by heating the fruit of Elais Guiniensis with hot water and then subjecting it to hot pressure.

Color, orange red, but bleached by exposure to light. *Odor*, pleasant. *Taste*, bland. *Melts* at 80.6° F. Rapidly becomes rancid on exposure. *Contains* olein, palmitin, and a coloring principle. *Uses*, mainly for soaps, sometimes as demulcent.

Cacao Butter.—Oleum Theobromæ, U. S. Obtained by hot pressure from the seeds of Theobroma Cacao deprived of their seed coats and crushed.

Color, yellowish, changing to white on exposure. Hard. *Odor*, aromatic. *Taste*, similar to chocolate. *Sp. gr.* .96. *Melts* at about 90° F. *Contains* olein, stearin, palmitin, arachin, and laurin. *Uses*, as a vehicle for suppositories and ointments. Demulcent.

Cocoanut Oil.—Oleum Cocois. Obtained from the seeds of Cocos nucifera by boiling them in water and applying hot pressure.

Color, white. Consistence of butter. *Odor*, peculiar. *Taste*, bland (but rapidly becomes rancid, when both odor and taste are disagreeable). *Melts* at about 80° F. *Contains* laurin, palmitin, stearin, myristin; also glycerides of caprinic, caprylic, and capronic acids.

Butter.—Butyrum. Obtained by churning the cream of cow's milk.

Color, yellow. *Consistency*, rather soft. *Odor*, pleasant, peculiar, but when rancid, disagreeable, owing to the presence of butyric acid. *Taste*, agreeable, bland. *Melts* at about 83°. *Contains* olein, palmitin, stearin, small quantities of glycerides of butyric, caprylic, capronic, and caprinic acids, and traces of an odorous principle.

Uses.—As a demulcent and sometimes in ointments. For pharmaceutical uses should be fresh, unsalted, and free from casein.

The principal non-odorous solid fats are:

Lard.—Adeps, U. S. Obtained from the fatty tissues of Sus scrofa by heating them with water and straining.

Color, white. *Consistence*, soft. *Taste*, bland. *Sp. gr.* .938. *Melts* at about 95° F. *Uses*, mainly in ointments and cerates.

Suet. Sevum, U. S. Obtained from the fatty tissues of the abdomen of Ovis aries by heating (preferably in a water bath) and straining.

Color, white. *Consistence*, hard. *Taste*, bland. *Melts* at about 115° F. *Contains* olein, stearin, and palmitin and a little leucin; that from the ox is similar in its properties.

Uses, in the preparation of cerates.

The second of the two principal divisions of the Fixed Oils consists of those which contain no *glycerin*, but instead a complex monatomic alcohol. They are called *waxes*, and are *solid* at ordinary temperatures. They include:

Bees' wax,	Chinese wax,	Brazil wax,
Myrtle wax,	Spermaceti wax,	Palm wax,

and some others.

The most important, pharmaceutically, are:

Wax.—Cera Flava, U. S. Obtained by melting honeycomb in hot water and separating the liquids by decantation.

Color, yellow. *Odor*, somewhat aromatic, honey-like. *Tasteless*, nearly. *Melts* at about 145° F. *Sp. gr.* .96. *Contains* cerin, myricin, aromatic and coloring matters.

White Wax.—Cera Alba, U. S. Is prepared from the yellow by exposing it in thin layers for some time to moisture and light. Melts at 149° F.

Wax is often adulterated with tallow or paraffin. The former is detected by its lower sp. gr., and by the fact that the mixture is softer than pure wax. Paraffin is best detected by heating one part of the suspected wax with five of sulphuric acid to 320° F., and diluting the mixture with distilled water. If paraffin be present it will separate out, since it is not affected by the acid, while the wax undergoes chemical change.

Uses, in cerates, plasters and ointments mainly.

Spermaceti.—Cetaceum, U. S. Obtained from deposits in cavities in the head of the sperm whale Physeter macrocephalus.

Color, white, translucent. *Consistence*, hard, crystalline. Without odor or taste. *Sp. gr.* about .95°. *Melts* at 122° F. *Composed* chiefly of cetin. *Uses*, in ointments and cerates.

Petroleum Ointme .—Petrolatum, U. S., or "Soft Paraffin," the residue left upon the distillation of the more volatile portions of petroleum. It consists of hydrocarbons chiefly of the marsh-gas series of compounds, viz.: Paraffins and a smaller proportion of Olefines.

Color, yellowish. *Taste* none. *Odor* slight, when heated, of petroleum. *Sp. gr.* from .835 to .860. *Consistence* usually soft, but as it depends upon the melting point, it varies with it, which is from 104° to 125° F. (40° to 51° C.)

The U. S. P. allows this variation, so that the petrolatum may be either *hard* or *soft*, and thus be used in ointments of various consistence. It directs, however, that when prescribed, without the melting point being specified, the *low-melting* variety (104°) is to be dispensed. (See U. S. P. '80.)

Petrolatum, owing to its quality of never becoming *rancid*, is largely used as a vehicle for ointments, instead of lard, but its use should be restricted to preparations for *surface* medication, and not in those intended for indermic medication

Emulsions.

Emulsions are mixtures in which fats, oils or oleo-resinous bodies are kept in *suspension* in water by gum or other substances possessing *emulsifying* properties.

An emulsion should contain the oil or fat minutely divided, but otherwise in its *natural* condition, by the intervention of a neutral or otherwise indifferent substance. An emulsion is regarded as being perfect when it is *miscible with water in any proportion* without liberating the oil, and may therefore be diluted to any extent.

A *natural* emulsion we have in milk, wherein the fat is kept suspended by the albuminous matter and casein.

Milk is a more perfect emulsion than any artificially prepared, the fat globules being discernible only by the use of a microscope; these in churning are ruptured, and the fat conglomerates into a mass which floats upon the watery fluid and constitutes *butter*.

Emulsions of ordinary fluidity will separate upon standing into two layers, the fat rising to the top, while the more watery portion sinks to the bottom of the vessel, just as cream rises in milk. This is probably due to the difference in specific gravity, and can be completely prevented only by removing the water by evaporation, as in the manufacture of condensed milk. The separation may be retarded for some time by increasing the density or *consistence* of the mixture by the use of extract of malt, condensed milk, etc., for emulsifying, or by the addition of gelatin, Irish moss, etc.; it is also frequently effected by the use of alkalies.

This separation in an emulsion, however, is no evidence of its imperfect preparation; only when the *oil globules separate* can the emulsification be regarded as incomplete.

Egg yelk is another natural emulsion in which the fat is suspended by an unknown substance, probably a ferment.

Natural emulsions may also be obtained from most of the *gum-resins*, and from many seeds or *nuts*, by simple trituration with water, as these contain the two principles necessary for an emulsion, *i. e.*, oil and gum.

Emulsion of Almonds is prepared by beating the kernels in a mortar to a moderately fine powder, and then adding the water gradually, expressing and straining. Emulsions of the gum resins, for example, of asafœtida, are more difficult to prepare, since they are usually not sufficiently friable to admit of being powdered, and also as a rule do not contain gum in the proportion required to emulsify the oil. These are therefore beaten in a mortar with about one-half their weight of powdered acacia until a uniform mixture is obtained; the water is then added.

The Volatile Oils, for example, the oil of turpentine, require also a greater proportion of gum for emulsification than fixed oils, because they contain no gum. These and oleo-resins should be mixed with *twice their weight* of powdered gum before the water is added. See also the process in Remington's Practice: 20 grains of powdered acacia, contained in a dry bottle, shaken with the oil, with gradual addition of the water.

The principal emulsifying agents in order of their merit are:

(1) Natural concentrated emulsions.

Condensed milk—especially adapted for emulsifying castor and cod-liver oil.

Egg yelk—which, mixed with an equal weight of glycerin to preserve it, is termed Glyconin.

With these the oil is added in small quantities at a time to the emulsifying agent, contained in a large, preferably flat-bottomed mortar, under rapid trituration, care being taken that each portion of oil is completely emulsified before more is added. These emulsions are apt to spoil, and should therefore be prepared freshly when wanted, and kept in a cold place.

(2) Gums and mucilages.

These are the emulsifying agents usually employed, the most generally useful being:

Gum Acacia—in powder. The best method is as follows:

Take of gum *one-half* as much as of the oil, and of water *one-half* the quantity *of these two* combined, viz.:

Gum, 2 parts; oil, 4 parts; water, 3 parts.

To the acacia contained in a perfectly dry mortar add the oil and mix thoroughly; then add the whole of the water *at once*, and triturate until the peculiar crackling noise is heard, caused by the emulsification. Water or substances dissolved in it may now be added, flavoring, etc.; alcoholic liquids, however, only when first diluted.

Glycerin and syrups are used for the purpose of sweetening; but, although sometimes making the emulsion more palatable, they induce separation very rapidly, because of their density.

Mucilages of acacia, Irish moss and tragacanth are also used, but the emulsions prepared with these are not so satisfactory as when powdered acacia is employed, as before described, nor are they as permanent.

Extract of malt is a very good emulsifying agent, especially for cod-liver oil, of which it also masks the taste. It should be used in the same manner as described under natural emulsions. A good extract of malt will emulsify its own weight of cod-liver oil.

(3) Animal Ferments.—Pancreatin.

Pancreatin.—A mixture of different ferments, when in alkaline media, acts as a powerful emulsifying agent.

Fats emulsified with pancreatin, however, are rarely permanent emulsions, although they are theoretically regarded as being the most natural, and are more easily assimilated than emulsions prepared with other agents.

For this reason, while pancreatin presents few advantages pharmaceutically as an emulsifying agent, it is of much value *therapeutically*, and is added to emulsions to make the emulsification more complete. It should be dissolved in a little water, rendered slightly *alkaline* by sodium carbonate, and added either before or immediately after the emulsification of the fat.

(4) Alkalies and Quillaya.

Alkalies, especially in the form of Lime Water and Solution of Potassa, are frequently used for emulsifying fats; but, as they combine with the fat acids and form *soap*, the process is really one of *saponification*.

Liquor potassa is often added to balsam copaiba, forming a cream-like liquid, which mixes with water, syrup, etc., but the therapeutic properties of the balsam are impaired by the resulting change.

Quillaya, or soap bark, has also been employed, but as it acts in the same manner as the alkalies, its use is not to be recommended.

Questions on Lecture V.—Series 8, 1891.

1. How many kinds of Salts may monobasic and dibasic Acids form?
2. What element is common to all Organic compounds?
3. What impurities are found in Oxalic Acid?
4. From what substance is Carbolic Acid obtained?
5. Name the officinal "Phenols."
6. How could you distinguish between them?
7. What acids does Benzoin contain, and how may each one be obtained?
8. Write the *chemical* formula of all the *officinal* Organic Acids.
9. What is the *solubility* of Carbolic Acid in various solvents?
10. Mention impurities liable to be found in Salicylic Acid.
11. What is the chemical relation of Ethers and Alcohols?
12. What is the *percentage* of Alcohol allowable in the U. S. P. Wines?
13. Why are Wines containing a small per cent. of *Alcohol* liable to deteriorate?
14. Enumerate the officinal Alcohols.
15. What relation does "Fusel Oil" bear to ordinary Alcohol, and how may it be eliminated from spirituous liquors?
16. How is Chloral Hydrate produced?
17. State its chemical composition.
18. What is meant by the term "Chloric Ether?"
19. How is starch formed in the plant?
20. What is the effect of concentrated Sulphuric Acid on starch?
21. Into how many and what groups are Sugars divided?
22. Into what principal groups are the Volatile Oils divided?
23. By what methods may they be obtained?
24. By what process may Lead Plaster be prepared *without* the production of *glycerin?*
25. To which groups, respectively, do Oil of Peppermint, Oil of Garlic, Oil of Wild Cherry and Oil of Turpentine belong?
26. State the difference between the *hydrocarbon* and the *empyreumatic* Volatile Oils.
27. Mention various common adulterants of the Volatile Oils, and how they may be detected.

IMPORTANT.

Students will please reply to the above questions on *letter-size* paper, *in ink*, writing only on *one* side of the paper, and forward promptly to the director, signed. In answering, it is *not* necessary to repeat the question itself but only the *number* of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

☞ In order to insure prompt attention all the rules of the "Important Notice" must be complied with.

Director.

National Institute of Pharmacy.

LECTURES, SEMI-MONTHLY, BY MAIL.
C. S. HALLBERG, Ph. G., *Director.*

DEPARTMENT OF EXAMINATIONS.

CHICAGO, Sept, 1891.

D. F. Carpenter, East Hampton, Conn.

Upon Questions on Lecture VI., Series 8, we transmit the following printed answers for further comparison and study:

1. Refer to lecture.
2. Resins are oxidation products of Volatile Oils.
3. Those of an acid character.
4. Medicated Waters, Spirits, Elixirs, and Oleo-Resins.
5. Mainly for the preparation of Ointments, Cerates, and Plasters.
6. It is an acid resin and consequently saponifiable
7. Gum-Resin, containing gum and resin.
8. Turpentine is an oleo-resin containing Oil of Turpentine as its volatile oil, and "Rosin" as the resin.
9. Refer to lecture.
10. Elaterium.
11. They are stimulants and expectorants.
12. Olein, Palmitin, Stearin, Laurin, and Myristin.
13. They are Salts (oleates, stearates, palmitates, etc.) of alcohol radicals; in other words, ethereal salts, compound ethers or esters.
14. Refer to lecture.
15. Cottonseed Oil.
16. Lard and Cod Liver Oils.
17. It is permanent, not becoming rancid.
18. *a.* 104° to 125° F. *b.* The lower melting variety.
19. A Fixed Oil is a salt of an organic base, Soap, of an inorganic base.
20. ——
21. Adeps Lanæ is derived from wool; Adeps Suillus from the fat of swine.

Your rating on answers to Lecture 6 *is* 81 *per cent.*

The abbreviations "P.," "Col." and Par.," are used to indicate "page," "column," and "paragraph," respectively.

In rating the answers, your *general understanding of the subjects* and the *appearance of your paper*, are also taken into consideration.

☞ The above questions should be *carefully reviewed* upon receipt of corrections. If questions to any other Lectures remain unanswered, please send them in at once.

THE DIRECTOR.

Always continue to answer in the regular order without waiting for delayed observations. Corrections are always forwarded as promptly as possible.

☞ **NOTICE.—Do not fail to write your name, full address and CLASS page** 627 **, at the TOP of the first page of your answers.**
In all correspondence the CLASS page must be stated in order to insure prompt attention.

The Pharmacy of Organic Drugs.*

CLASSIFICATION.

Organic drugs may be separated into two groups so far as their origin is concerned, viz.: (1) Those derived from the vegetable kingdom, as Cinchona, Opium, Sarsaparilla, and (2), those derived from the animal kingdom, as Musk, Ichthyocolla and Cantharides.

For the purpose of pharmacy, however, a classification based upon the nature of the constituents is more desirable; though, owing to the complex character of many drugs, and to the fact that the constituents as well as the physiological action of many others are imperfectly understood, and also to various other reasons, such a classification is difficult to make, and one that is absolutely free from objection is impossible in the present state of our knowledge. All that is claimed for the following attempt is that it presents many conveniences to the learner, and aids in the selection of the proper mode of extraction, menstrua to be employed, and pharmaceutical treatment generally, of the different classes of drugs.

On the basis of their constituents, organic drugs may be grouped as follows:

I. Drugs destitute of active medicinal constituents.
- 1. *Demulcent drugs.* Valuable chiefly for their cellulose, lignin, amyloids, sugars, gum, mucilage, bland fixed oils, coloring matters, etc.

II. Drugs possessing active medicinal constituents.
- 2. *Aromatic drugs*, or drugs chiefly valuable for an aromatic volatile oil, or other aromatic constituents.
- 3. *Resinous drugs*, or drugs whose virtues are chiefly or wholly due to an acrid or bitter resin, an acrid fixed oil, or to extractive matter either associated or not with a volatile oil.
- 4. *Astringent drugs*, or those whose virtues depend chiefly upon the presence of astringent principles (tannic or gallic acids).
- 5. *Refrigerant drugs*, or those whose virtues depend partly or chiefly on the presence of organic acids, such as citric, malic and tartaric acids.
- 6. *Glucosidal drugs.* Under this will be included those drugs whose virtues depend largely on the presence of glucosides, neutral principles, or peculiar acids.
- 7. *Alkaloidal drugs*, or those whose virtues depend partly or wholly on the presence of one or more alkaloids.

III. Unclassified drugs.
- 8. Under this head will be included all those vegetable drugs whose active constituents are unknown, or which, if known, cannot properly be classed under any of the above heads, and also all *Animal drugs.*

In some cases the drugs described possess constituents which would nearly equally entitle them to classification under two or more of the above groups. In such cases (where the drugs are officinal) they will be described only under one of the groups, and merely named in the others, with reference back to the group in which their description occurs.

Following the description of the officinal drugs of each group will be a list of the more important unofficinal drugs, with their sources and more important constituents.

A distinction should be observed between the *officinal* (U. S. P.) preparations of a crude drug and others in frequent use, not officinal. Also between the officinal *Latin* pharmaceutical title of a crude drug and its botanical source, and between the officinal *English* title and the many indefinite ones in common use. (See Lecture I, page 5).

GROUP I — DEMULCENT DRUGS.

Drugs destitute of active medicinal constituents, and valuable chiefly for their cellulose, lignin, amyloids, sugars, gum, mucilage, bland fixed oils, coloring matter, etc.

Of the following drugs, Gossypium, Hæmatoxylon, Lycopodium, and Santalum are not *demulcent*, but included in this Group for want of a better classification.

Sweet Almond.—Amygdala dulcis U. S.—Seeds of Amygdala communis, var. dulcis, De Candolle. Nat. Ord. Rosaceæ. Constituents: fixed oil about 50 per cent., mucilage, sugar, etc. Officinal Preparations: Mistura Amygdalæ; Syrupus Amygdalæ.

Pharm. Uses: For obtaining oleum amygdalæ express.; emulsion, used as a vehicle for other substances and as flour or paste for cosmetic preparations.

Althæa.—Althæa, U. S.—Marshmallow.—Root of Althæa officinalis, Linnè. Nat. Ord., Malvaceæ. Constituents: starch 37 per cent., mucilage, asparagin, etc. Officinal Preparation: Syrupus Althæa.

Pharm. Uses: Owing to the large proportion of starch it contains, preparations of althæa must always be prepared without the use of heat in the extraction (see infusion). The root occurs in commerce in the form of small cubes, and as such is largely used as an ingredient in Species Pectorales P. Ger.; also for preparing a demulcent drink. The powder, owing to its absorbing qualities, is largely used in pill masses.

Cetraria.—Cetraria, U. S.—Iceland Moss. Entire plant of Cetraria Islandica, Acharius. Nat. Ord., Lichenes. Constituents: lichenin or lichen starch, 70 per cent., cetraric acid, etc. Officinal Preparation: Decoctum Cetrariæ.

Pharm. Uses: In the preparation of Iceland moss jelly, it is desirable to free the moss from the cetraric acid, to which the bitter taste is due, by macerating it in tepid water for half an hour, expressing the liquid which is rejected, and then exhausting the moss by boiling water, and straining. To the strained liquid sugar is added, and the mixture evaporated to jelly consistency.

* Only such organic drugs will here be treated as have not been sufficiently described in previous lectures. (See Lectures V and VI.)

Organic Drugs—(Continued).

Chondrus.—Chondrus, U. S.—Irish Moss. Plant of Chondrus crispus, Lyngbye. C. mamillosus, Greville. Nat. Order, Florideæ of the class Carpophyta. Constituents: mucilage, and traces of iodides, bromides, sulphates. Does not contain starch.

Pharm. Uses: Chiefly in the form of a mucilage as an emulsifying agent. The decoction of Irish moss and Carrageen jelly are both prepared similarly to those from cetraria.

Cotton.—Gossypium U. S.—Purified or absorbent Cotton. Hairs of seeds of Gossypium herbaceum, Linnè, and other species of Gossypium, freed by washing in alkaline water from fatty matter and other impurities. (Lecture V). Constituents: cellulose. Off. Preparations: Pyroxylinum.

Phar. Uses: Absorbent Cotton impregnated with various substances, such as carbolic acid, iodine, etc., is extensively employed in surgery. In pharmacy it is used as a filtering medium.

Cydonium.—Cydonium, U. S.—Quince seed, Seed of Cydonia vulgaris, Persoon. Nat. Ord., Rosaceæ. Constituents: mucilage. Off. Preparation: Mucilago Cydonii.

Pharm. Uses: Mostly as a demulcent in the form of mucilage. Also largely as a hair dressing; the mucilage having but little adhesive power renders it sometimes preferable to tragacanth for that purpose.

Elm.—Ulmus, U. S.—Slippery Elm. Inner bark of Ulmus fulva, Michaux. Nat. Ord., Urticaceæ. Constituents: mucilage. Off. Preparation: Mucilago Ulmi.

Pharm. Uses: Somewhat as a demulcent, but chiefly for poultices, when it should be coarsely ground so that the mass will adhere together when moistened with water.

Flax Seed.—Linum, U. S.—Seeds of Linum usitatissimum, Linnè. Nat. Ord., Linaceæ. Constituents: mucilage, fixed oils about 40 per cent.

Pharm. Uses: Ground flaxseed, "Lini Farina," for poultices. When deprived of oil, it is termed "oil cake," which is said to make an excellent cataplasm. From the whole seeds "flaxseed tea" is prepared, and with the addition of liquorice and a little lemon juice, furnishes a refreshing draught.

Fig.—Ficus, U. S.—The fruit of Ficus Carica, Linnè. Nat. Ord., Urticaceæ, Constituents: sugar, gum, etc. Off. Preparation: Confectio Sennæ.

Hæmatoxylon.—Hæmatoxylon, U. S.—Logwood. Heartwood of Hæmatoxylon Campechianum, Linnè. Nat. Ord., Leguminosæ. Constituents: hæmatoxylin, tannin and resin. Off. Preparation: Extractum Hæmatoxyli.

Pharm. Uses: As an addition to astringent mixtures, but chiefly for dyeing and in the preparation of Inks.

Lycopodium.—Lycopodium, U. S.—Spores of Lycopodium clavatum, Linnè, and other species of Lycopodium. Nat. Ord., Lycopodiaceæ. Constituents: fixed oil 47 per cent.

Pharm. Uses: As a protective for raw and inflamed surfaces. Also as a "dusting powder" for pills.

Lycopodium is very combustible, burning with a fine rose-colored flame, and is largely used in pyrotechnics. It should be kept remote from light and fire.

Malt.—Maltum, U. S.—Seed of Hordeum distichum, Linnè, caused to begin germination and then dried. Nat. Ord., Graminaceæ. Constituents: dextrin, diastase, sugar, starch, etc. Off. Preparation: Extractum Malti.

Diastase during the process of malting converts part of the starch into dextrin and sugar, and subsequently when the malt is "mashed," in brewing and in preparing malt extract, all the starch is converted into these compounds by the action of the diastase, which sets in at a certain temperature. Diastase is a peculiar ferment, which is destroyed at a high temperature, hence the necessity of not exceeding 160° F. in the process of conversion.

Manna.—Manna, U. S.—Sugary exudation from Fraxinus ornus, Linnè. Nat. Ord., Oleaceæ. Constituents: mannit 90 per cent., glucose, resin, fraxin. Off. Preparation: Infusum Sennæ compositum.

Syrupus Mannæ., P. Ger., by dissolving ten parts manna in forty parts water, filtering and dissolving in it fifty parts sugar. This syrup ferments very easily, and should be prepared only in very small quantities.

Prune.—Prunum, U. S.—Fruit of Prunus domestica, Linnè. Nat. Ord., Rosaceæ. Constituents: sugar, pectin, etc. Off. Preparation: Confectio Sennæ.

Sassafras Pith.—Sassafras medulla, U. S.—Pith of Sassafras officinalis, Nees. Nat. Ord., Lauraceæ. Constituents: mucilage. Off. Preparation: Mucilago Sassafras.

Pharm. Uses: In the preparation of Jackson's Pectoral Syrup; for collyria, and as a vehicle for more active remedies.

Red Saunders.—Santalum rubrum, U. S.—Wood of Pterocarpus santalinus, Linnè. Nat. Ord., Leguminosæ. Constituents: santalic acid, santalin and pterocarpin. Off. Preparation: Tinctura Lavandulæ comp.

Pharm. Uses: As a dye and for coloring Fowler's Solution by the use of tincture lavender compound.

Triticum.—Tritieum, U. S.—Couch Grass. Rhizome of Triticum repens, Linnè. Nat. Ord., Graminaceæ. Constituents: sugars, tritiein (similar to inulin). Off. Preparation: Extractum Tritici Fluidum.

Pharm. Uses: In the form of decoction in various diseases of the urinary organs. It makes a pleasant drink, and may be used freely. The fluid extract, largely diluted with water, may likewise be used.

UNOFFICINAL DRUGS—GROUP ONE.

Com. Name.	Bot. Name	Part Used.	Constituents.
Adansonia.	Adansonia digitata.	Bark.	Mucilage.
Adiantum.	Adiantum pedatum.	Frond.	Mucilage.
Alkanet.	Alkanna tinctoria.	Root.	Anchusin.
Borage.	Borago officinalis.	Herb	Mucilage.
Chicory.	Cichorium Intybus.	Root.	Inulin.
Salep.	Orchis Mascula and other sp. of Orchis.	Tubers.	Pectin. Mucilage.
Sesamum.	Sesamum Indicum.	Leaves.	Mucilage.
Tonka.	Dipterix odorata.	Seed.	Coumarin, fixed oil.
Verbascum (Mullein).	Verbascum Thapsus.	Leaves & Root.	Mucilage & little volatile oil.

Aromatic Drugs.

GROUP TWO—AROMATIC DRUGS.

This Group includes those vegetable drugs whose chief value consists in the volatile oil which they contain. They are mostly stimulant and carminative in their properties.

A few of them, Buchu, Cubeb, Eucalyptus, Ginger and Valerian, are sufficiently active to be administered alone in simple preparations, but the rest are merely used as aromatics and adjuvants, and enter largely into various compounds. Their preparations, with one or two exceptions, precipitate with water, and in the degree this precipitation takes place, the strength of the preparation, or the quality of the drug from which it is prepared, may be roughly estimated.

Nearly all require stronger alcoholic menstrua in their extraction, yet the solvent should contain some water which, by causing the cell-walls to swell, enables the alcohol to dissolve the active constituents and facilitate the extraction of the drug.

The active principles or volatile oils of some of the drugs belonging to this class, especially those of the Orange and Rose families, are soluble *to some extent* in syrup, which is the most common form of exhibition; they are, however, still less soluble in water not containing sugar, and such solutions can not, therefore, be so concentrated that the syrups can be prepared from them by admixture with simple syrup. Their principal use is in the manufacture of essential oils.

Absinthium. (See Group 3).

Anise.—Anisum, U. S.—Fruit of Pimpinella anisum, Linnè, Nat. Ord., Umbelliferæ. Constituents: vol. oil about two per cent., sugar, mucilage, etc. Off. Preparation: Tinctura Rhei Dulcis.

Arnica.—Flowers and Root. (See Group 3).

Buchu.—Buchu, U. S.—Leaves of Barosma betulina, Bart., B. crenulata, Hook., and B. serratifolia, Willd. Nat. Ord., Rutaceæ. Constituents: vol. oil about one per cent., resin, bitter principle, etc. Off. Preparations: Extractum Buchu Fluidum. Tinctura Buchu was formally officinal.

Short buchu is the only kind recognized in the U. S. P. It contains a larger percentage of oil than the variety known as "long" buchu (B. serratifolia) and is much lower in price.

Calamus.—Calamus, U. S.—Rhizome of Acorus Calamus, Linnè. Nat. Ord., Araceæ. Constituents: vol. oil one-half per cent., bitter principle, resin, etc. Off. Preparation: Extractum Calami Fluidum.

Pharm. Uses: A tincture containg 20 per cent. of the drug made with alcohol, sp. gr. 0.892 and an extract with 60 per cent alcohol, are prepared according to the P. Ger. Infusion is made with one ounce to the pint. A conserve is also made from the peeled root with sugar.

Caraway.—Carum, U. S.—Fruit of Carum Carui, Linnè. Nat. Ord., Umbelliferæ. Constituents: vol. oil six per cent. Off. Preparation: Tinctura Cardamomi comp.

Pharm. Uses: As an aromatic in different Elixirs and "Tonics;" also as condiment, and as an ingredient in cheese.

Cardamom.—Cardamomum, U. S.—Fruit of Elettaria Cardamomum, Maton. Nat. Ord., Zingiberaceæ. Constituents: vol. oil four-fifths per cent., fixed oil, mucilage, etc. Off. Preparations: Pulvis Aromaticus; Tinctura Cardamomi; Tinctura Cardamomi composita; Tinctura Gentianæ comp.; Tinctura Rhei; Tinctura Rhei Dulcis; Vinum Aloes; Extract. Colocynthidis comp.

Malabar and Aleppo constitute the shorter varieties of Cardamon, which are round in shape, while the Madras are more elongated. Good Cardamom should yield 75 per cent. of their weight in seeds.

Cascarilla.—Cascarilla, U. S.—Bark of Croton Eluteria, Bennett. Nat. Ord., Euphorbiaceæ. Constituents: vol. oil one-fifth per cent. cascarillin, and resin.

Pharm. Uses: Chiefly as an ingredient in "fumigating mixtures." When incinerated, it gives off an odor resembling that of musk.

Extractum Cascarillæ P. Ger. is prepared by exhausting the bark with hot water and evaporating the liquid.

Chenopodium.—Chenopodium, U. S.—American Wormseed. Fruit of Chenopodium ambrosioides, var. Anthelminticum, Gray. Nat. Ord., Chenopodiaceæ. Constituents: volatile oil.

Pharm. Uses: In the form of infusion and for the preparation of the volatile oil.

Cinnamon.—Cinnamomum, U. S.—Inner bark of shoots of Cinnamomum Zeylanicum, Breyne (Ceylon or true cinnamon); or inner bark of Cinnamomum Cassia and some undetermined species of cinnamon. Nat. Ord., Lauraceæ. Constituents: vol. oil about one per cent., tannin, sugar, etc. Off. Preparations: Pulvis Aromaticus; Infusum Digitalis; Tinctura Cinnamomi; Tinct. Cardamomi comp.; Tinct. Catechu comp.; Tinct. Lavandulæ comp.; Tinct. Rhei Aromat.; Vinum Opii; also in numerous unofficinal preparations and in Elixirs.

Pharm. Uses: In the powdered form as a spice and sometimes for dusting pills. Cassia Cinnamon is the kind mostly used for culinary purpose; Chinese for flavoring cordials, cachous, elixirs, etc.; Ceylon Cinnamon in perfumery, also for flavoring, as in preparing Aqua Cinnamomi P. Br.

Cloves.—Caryophyllus, U. S.—Unexpanded flowers of Eugenia Caryophyllata, Thunberg. Nat. Ord., Myrtaceæ. Constituents: volatile oil eighteen per cent., caryophyllin, eugenin, resin, tannin, etc. Off. Preparations: Tinctura Lavandulæ comp.; Tinct. Rhei Arom.; Vinum Opii, and externally as an ingredient in the unofficinal Spice Plaster.

Coriander.—Coriandrum, U. S.—Fruit of Coriandrum sativum, Linnè. Nat. Ord., Umbelliferæ. Constituents: volatile oil one-half per cent. and fixed oil.

Pharm. Uses: To correct griping in laxative remedies as in the officinal Confection of Senna; as a very agreeable flavor in Elixirs, and as a promoter of digestion in the compound of various spices, known as "Curry Powder."

Aromatic Drugs—(Continued).

Cubeb.—Cubeba, U. S.—Unripe fruit of Cubeba officinalis, Miquel. Nat. Ord., Piperaceæ. Constituents: volatile oil ten per cent., resin, cubebin, cubebic acid. Off. Preparations: Extractum Cubebæ Fluidum; Oleoresina Cubebæ; Tinctura Cubebæ.

Cubebic acid and cubebin, also described as indifferent resin, represent all the medicinal value of cubeb, the oil being regarded as nearly inert.

Pharm. Uses: Crushed and made into cigarettes for smoking, powdered and mixed with potassium sulphate as Catarrh Snuff, and made into a paste with mucilage and copaiba for gonorrhœa.

Eucalyptus.—Eucalyptus, U. S.—Leaves of Eucalyptus globulus, Labillardière. Nat. Ord., Myrtaceæ. Constituents: volatile oil six per cent., resin, tannin. Off. Preparation: Extractum Eucalypti Fluidum.

Pharm. Uses: As an addition to quinine mixtures, and externally as a wash in Gangrene, etc.; also in conjunction with cubeb for smoking in Catarrh.

Fennel.—Fœniculum, U. S.—Fruit of Fœniculum vulgare, Gærtner. Nat. Ord., Umbelliferæ. Constituents: volatile oil about four per cent., fixed oil, sugar. Off. Preparation: Infusum Sennæ comp.

Pharm. Uses: In Species Laxantes P. Ger., "St. Germain" or "Hamburger The" and similar preparations to correct the harsh action of purgatives; also largely as infusion for children.

Gaultheria.—Gaultheria, U. S.—Wintergreen. Leaves of Gaultheria procumbens, Linnè. Nat. Ord., Ericaceæ. Constituents: volatile oil, five per cent., ericolin, arbutin, urson, tannin, etc.

Pharm. Uses: As a flavoring agent in Syrup Sarsaparilla comp. and as Infusion. The oil is most usually employed, and the Spirit of Wintergreen is officinal.

Ginger.—Zingiber, U. S.—Rhizome of Zingiber officinale, Roscoe. Nat. Ord., Zingiberaceæ. Constituents: volatile oil one-half per cent., gingerol, resin, starch, etc. Off. Preparations: Extractum Zingiberis Fluidum; Oleoresina Zingiberis; Pulvus Aromaticus; Tinctura Zingiberis; Vinum Aloes.

Ginger occurs in the market usually with the outer integuments removed, when it is called "uncoated ginger;" it is also frequently bleached by immersion in a solution of chlorinated lime to give it a white appearance. Of the two varieties, the African and the Jamaica, only the latter (unbleached) should be used in pharmacy.

Pharm. Uses: Similar to the other spices, and as an ingredient in "Curry Powder."

Hedeoma.—Hedeoma, U. S.—Pennyroyal. Leaves and flowering tops of Hedeoma pulegioides, Persoon. Nat. Ord., Labiatæ. Constituents: volatile oil.

Pharm. Uses: As infusion to bring on retarded or suspended menstruation.

Illicium.—Illicium, U. S.—Star-anise. Fruit of Illicium Anisatum, Loureiro. Nat. Ord., Magnoliaceæ. Constituents: volatile oil about four per cent., fixed oil about fifteen per cent., and resin and some tannin.

Pharm. Uses: As a substitute for pimpinella anise and as a source of oil of anise. It possesses a delicious flavor.

Juniper. (See Group 3).

Lavender.—Lavandula, U. S.—Flowers of Lavandula vera, De Candolle. Nat. Ord., Labiatæ. Constituents: volatile oil one and a half per cent., resin, and a little tannin. Off. Preparations: Tinctura Lavandulæ comp; Vinum Aromaticum.

Pharm. Uses: In perfumery, lavender water by distillation, and in Fumigating Powder.

Lemon Peel.—Limonis Cortex, U. S.—Rind of fruit of Citrus Limonium, Risso. Nat. Ord., Aurantiaceæ. Constituents: volatile oil two per cent., hesperidin. Off. Preparation: Spiritus Limonis.

Pharm. Uses: For flavoring, and in the Spirit of Lemon for imparting a lemon-yellow color to the alcoholic solution of the oil.

Mace.—Macis, U. S.—Aril of nutmeg, Myristica fragrans, Houttuyn. Nat. Ord., Myristicaceæ. Constituents: volatile oil about eight per cent., fixed oil, resin.

Pharm. Uses: Tincture of Mace, P. Ger. is prepared by digesting one part of mace in five parts alcohol. Mace is mostly used as a condiment, and as it cannot be powdered without addition of other substances, should be used whole.

Magnolia.—Magnolia, U. S.—Bark of Magnolia glauca, Linnè, M. acuminata, Linnè, and M. tripetala, Linnè. Nat. Ord., Magnoliaceæ. Constituents: volatile oil, resin (pungent), tannin, magnolin. Rarely used in pharmacy.

Marrubium.—Marrubium, U. S.—Horehound. Leaves and tops of Marrubium vulgare, Linnè. Nat. Ord., Labiatæ. Constituents: volatile oil, resin, marrubin, tannin.

Pharm. Uses: Popularly as an ingredient in Cough Syrups and as Infusion.

Matico.—(See Group 3).

Melissa.—Melissa, U. S.—Balm. Leaves and tops of Melissa officinalis, Linnè. Nat. Ord., Labiatæ. Constituents: volatile oil one-sixth per cent., tannin, bitter extractive.

Pharm. Uses: For preparing Aqua Melissa P. Ger. by distillation with water; also in a French preparation, "Eau de Carmes," or Compound Spirit of Balm.

Nutmeg.—Myristica, U. S.—Kernel of seed of Myristica fragrans, Houttuyn. Nat. Ord., Myristicaceæ. Constituents: volatile oil about five per cent., and fixed oil twenty-five to thirty per cent. Off. Preparations: Pulvis Aromaticus; Acetum Opii; Tinctura Lavandulæ composita; Tinct. Rhei Arom.; and as a flavor in several officinal Troches.

Origanum.—Origanum, U. S.—Wild Marjoram. Leaves and tops of Origanum vulgare, Linnè. Nat. Ord., Labiatæ. Constituents: volatile oil one per cent., resin and bitter principle.

Pharm. Uses: Only for the preparation of Oil Origanum. A cultivated variety, Sweet Marjoram, is largely used as a condiment.

Aromatic Drugs—(Continued).

Orange Flowers.—Aurantii Flores, U. S.—The partly expanded, fresh flowers of Citrus Aurantium, Risso, and C. vulgaris, Risso. Nat. Ord., Aurantiaceæ. Constituent: volatile oil. Off. Preparation: Aqua Aurantii Florum.

Pharm. Uses: For the preparation of Orange flower water by distillation and for obtaining Oil of Neroli.

Bitter Orange Peel.—Aurantii Amari Cortex, U. S.—Rind of fruit of Citrus vulgaris, Risso. Nat. Ord., Aurantiaceæ. Constituents: volatile oil and hesperidin. Off. Preparations. Extractum Aurantii Amari Fluidum; Tinctura Aurantii Amari; Tinct. Cinchonæ comp.; Tinct. Gentianæ comp.

Pharm. Uses: Owing to its large percentage of bitter principle, Bitter Orange Peel is used in the several officinal tinctures, and also in many unofficinal tonics and bitters. The volatile oil, while present in much smaller quantity than in the Sweet Orange Peel, is largely used, and sometimes preferred to that of the latter. The volatile oil obtained from the unripe fruit of bitter orange (orange berries) called *essence de petit grain*, is similar in chemical composition, but differs in the physical characteristics of taste and odor.

Sweet Orange Peel.—Aurantii Dulcis Cortex, U. S.—Rind of fruit of Citrus Aurantium, Risso. Nat. Ord., Aurantiaceæ. Constituents: volatile oil and hesperidin. Off. Preparations: Syrupus Aurantii Cort.; Tinctura Aurantii Dulcis.

Pharm. Uses: The fresh rind, when obtainable, should always be given the preference over the dried, when used for flavoring purposes. A tincture is made by macerating the yellow exterior portion, deprived of the inner white fleshy portion, with alcohol, and expressing. It is the chief flavor for Elixirs.

Piper.—Piper, U. S.—Black Pepper. Unripe fruit of Piper nigrum, Linnè. Nat. Ord., Piperaceæ. Constituents: volatile oil one-half per cent., piperin, pungent resin. Off. Preparation: Oleoresina Piperis.

Pharm Uses: Sometimes as an addition to Anti-Chill Pills to render other remedies, such as quinine, more active. It is the best known and more largely used of all condiments. The powder is often largely adulterated.

Peppermint.—Mentha Piperita, U. S.—Leaves and tops of Mentha piperita, Linnè. Nat. Ord., Labiatæ. Constituents: volatile oil one per cent., pipmenthol, resin, tannin. Off. Preparations: Spiritus Menthæ Piperitæ; Vinum Aromaticum.

Pharm. Uses: Almost exclusively for obtaining oil of Peppermint; also for imparting a green color to the alcoholic solution of the oil in Essence of Peppermint, and as Infusion.

Pimenta.—Pimenta, U. S.—Allspice. Nearly ripe fruit of Eugenia Pimenta, De Candolle. Nat. Ord., Myrtaceæ. Constituents: volatile oil three-fourths per cent., resin, tannin, etc.

Pharm. Uses: Exclusively as a condiment and for obtaining the oil, which is used in the preparation of "Bay Rum."

Pale Rose.—Rosa Centifolia, U. S.—Petals of Rosa centifolia, Linnè. Nat. Ord., Rosaceæ. Constituents: volatile oil, sugar, mucilage, tannin. Off. Preparations: Aqua Rosæ; Syrupus Sarsaparillæ compositus.

Pharm. Uses: In perfumery; in the distillation of Rose Water and in Fumigating Powder.

Red Rose.—Rosa Gallica, U. S.—Petals of Rosa Gallica, Linnè. Nat. Ord., Rosaceæ. Collected before flowers are fully expanded. Constituents: volatile oil, sugar, mucilage, quercitrin. Off. Preparations: Pilulæ Aloes et Mastiches; Confectio Rosæ; Extractum Rosæ Fluidum; Mel Rosæ; Syrupus Rosæ.

Pharm. Uses: The infusion, formerly officinal, containing sugar and dilute sulphuric acid, as a vehicle for bitter drugs, *i. e.*, magnesium sulphate and quinine; also as a gargle for sore throat.

Rosemary.—Rosmarinus, U. S.—Leaves of Rosmarinus officinalis, Linnè. Nat. Ord., Labiatæ. Constituents: volatile oil one per cent., resin, tannin, bitter principle. Off. Preparation: Vinum Aromaticum.

Pharm. Uses: In perfumery and in Fumigating Powder.

Saffron.—Crocus, U. S.—Stigmas of Crocus sativus, Linnè. Nat. Ord., Iridaceæ. Constituents: volatile oil, crocin. Off. Preparation: Tinctura Croci; also Syrupus Croci, French Codex.

Pharm. Uses: Chiefly as a dye and as infusion to produce diaphoresis in "measles." It enters also largely into preparations of the older Pharmacopœias. Saffron is largely adulterated; the so-called American Saffron is from an entirely different plant (Carthamus), and should not be dispensed as a substitute for Crocus.

Salvia.—Salvia, U. S.—Sage. Leaves of Salvia officinalis, Linnè. Nat. Ord., Labiatæ. Constituents: volatile oil one-half to three-quarters per cent., resin, tannin, extractive matter. Off. Preparation: Vinum Aromaticum.

Pharm. Uses: Infusion in sore mouth and as a gargle in sore throat.

Sambucus.—Sambucus, U. S.—Elder.—Flowers of Sambucus Canadensis, Linnè. Nat. Ord., Caprifoliaceæ. Constituents: volatile oil, resin, mucilage, etc.

Pharm Uses: In Compound Syrup of Stillingia; in Species Laxantes P. Ger. and as Infusion.

Sassafras.—Sassafras, U. S.—Root bark of Sassafras officinalis, Nees. Nat. Ord., Lauraceæ. Constituents: volatile oil four per cent., tannin six per cent., sassafrid nine per cent. Off. Preparations: Decoctum Sarsaparillæ comp.; Extractum Sarsaparillæ comp. fluidum.

Pharm. Uses: Chiefly in the preparation of the oil sassafras by distillation; in infusion as "tea" for purifying the blood, and in Species Lignorum P. Ger.

Scutellaria.—Scutellaria, U. S.—Skullcap. Plant of Scutellaria lateriflora, Linnè. Nat. Ord., Labiatæ. Constituents: volatile oil, bitter principle, tannin. Off. Preparation: Extractum Scutellariæ Fluidum.

Aromatic Drugs—(Concluded).

Spearmint.—Mentha viridis, U. S.—Leaves and tops of Mentha viridis, Linnè. Nat. Ord., Labiatæ. Constituents: volatile oil about one-half per cent., resin, etc. Off. Preparation: Spiritus Menthæ Viridis.

Sumbul.—Sumbul, U. S.—Root of Ferula Sumbul, Hooker filius. Nat. Ord., Umbelliferæ. Constituents: volatile oil one-third per cent., angelic and valerianic acids and bitter extractive. Off. Preparation: Tinctura Sumbul.

Tansy.—Tanacetum, U. S.—Leaves and tops of Tanacetum vulgare, Linné. Nat. Ord., Compositæ. Constituents: volatile oil one-fourth per cent., bitter principle, resin, tannin.

Pharm. Uses: Infusion to bring on suspended menstruation, and in the preparation of the oil.

Thuja. (See Group 3).

Valerian.—Valeriana, U. S.—Rhizome and rootlets of Valeriana officinalis, Linnè. Nat. Ord., Valerianaceæ. Constituents: volatile oil one-half to two per cent., valerianic, formic and acetic acids, and resin. Off. Preparations: Abstractum Valerianæ; Extractum Valerianæ Fluidum; Tinctura Valerianæ; Tincturæ Ammoniata.

Two kinds of Valerian are found in the market, viz.: English and German, the former being regarded as containing the medicinally valuable constituents in a higher degree than the German. It should always be given the preference, but never used until freed from adhering dirt by washing with water.

Pharm. Uses: Infusion and the powder in the form of pills.

Extract of Valerian was discarded in the U. S. P. '80, the Abstract taking its place; the abstract represents the drug quite as fully as the extract, and may be dispensed in the same dose.

Vanilla.—Vanilla, U. S.—Fruit of Vanilla planifolia, Andrews. Nat. Ord., Orchidaceæ. Constituents: vanillin, fixed oil, resin. Off. Preparation: Tinctura Vanillæ.

Pharm. Uses: As a flavoring agent in the form of Tincture, or triturated to a fine powder with sugar of milk or rock-candy—frequently with an admixture of Tonka.

The following unofficinal preparations are mixtures of various drugs, most of which are included in Groups 1 and 2, and included in the "National Formulary:"

Breast Tea.—Species Pectorales, P. Ger.; Althæ, 8; Glycyrrhiza, Russian, peeled, 3; Orris, 1; Coltsfoot, 4; Mullein flowers, 2, and Anise (star), 2 parts. Contuse and mix.

Laxative Tea.—Species Laxantes P. Ger.; Senna, 16; Elder flowers, 10; Fenuel, 5; Anise, 5, and Potassium Bitartrate, 4 parts. To the Senna (cut) add the potassium bitartrate, then the other ingredients, and mix the whole thoroughly.

Wood Tea.—Species Lignorum, P. Ger. "Blood-purifying Tea." Guaiacum wood, 5; Ononis (Rest-harrow root), 3; Glycyrrhiza, Russian, peeled, and Sassafras, each, one part; mix.

Fumigating Powder.—A mixture of Lavender, Rose. Rosemary, Orris, etc., in various proportions for incinerating in sick chambers, etc. For a popular formula see Western Druggist, Vol. VI, No. 4, page 87.

UNOFFICINAL DRUGS—GROUP TWO.

Com. Name.	Bot. Name.	Part Used.	Constituents.
Achillæa (Yarrow).	Achilleæa millefolium.	Herb.	Volatile oil, achilleine, resin, tannin.
Angelica.	Archangelica officinalis.	Root.	Volatile oil, volatile acids, resins.
Angelica (American).	Archangelica atropurpurea.	Root.	(Same as above).
Apium.	Apium graveolens.	Fruit.	Vol. oil, fixed oil, etc.
Artemisia.	Artemisia vulgaris.	Herb.	Vol. oil, bitter principle.
Asarum (Canada Snake Root)	Asarum Canadense.	R'zome.	Vol. oil 3 per cent., resin, coloring matter.
Benzoin Bush.	Benzoin odoriferum.	Bark & Fruit.	Volatile oil, tannin.
Canella.	Canella alba.	Bark.	Volatile oil, resin, bitter principle.
Cataria.	Nepeta Cataria.	Herb.	Vol. oil, bitter principle.
Comptonia.	Comptonia asplenifolia.	Leaves.	Volatile oil, resin, tannin, alkaloid?
Cotula (Mayweed).	Maruta Cotula.	Herb.	Vol. oil, anthemic and valeric acids, acrid fixed oil.
Erigeron (Fleabane).	Erigeron Canadeusis	Herb.	Vol. oil, bitter principle.
Eryodicty'n	Eriodictyon Californicum.	Leaves.	Vol. oil, resin.
Glechoma.	Glechoma Hederaceæ.	Herb.	Vol. oil, bitter principle.
Golden Rod.	Solidago odora.	Herb.	Volatile oil.
Hyssop.	Hyssopus officinalis.	Herb.	Volatile oil, bitter principle, tannin.
Imperatoria	Imperatoria Ostruthenm.	Root.	Volatile oil ¾ per cent., Imperatorin.
Iris (orris).	Iris Florentina.	R'zome.	Vol. oil, resin, bitter extractive, starch.
Juniper (Virginia).	Juniperus Virginiana.	Twigs.	Volatile oil, resin.
Laurel.	Laurus nobilis.	Leaves.	Volatile oil and bitter principle.
Levisticum (Lovage)	Levisticum officinale	Root.	Volatile oil, bitter extractive, resins.
Marjoram.	Origanum Majorana	Herb.	Volatile oil.
Micromeria	Micromeria Douglassii.	Herb.	Volatile oil.
Parsley.	Petroselinum sativum.	Root & Seed.	Volatile oil, apiin.
Pimpernel.	Pimpernella saxifraga.	Root.	Volatile oil and acrid resin.
Rhus (aromatic).	Rhus Aromatica.	Root-bark.	Volatile oil, resin, tannin.
Sandal wood	Santalum album.	Wood.	Vol. oil ¼ per cent., resin.
Sarsaparilla (False).	Aralia nudicaulis.	R'zome.	Volatile oil and resin.
Spikenard (American).	Aralia racemosa.	R'zome & Root.	Volatile oil and resin.
Thyme.	Thymus vulgaris.	Herb.	Vol. oil, resin.
Turmeric.	Curcuma longa.	R'zome.	Vol. oil, pungent resin.
Wintera.	Drimy's Winteri.	Bark.	Vol. oil, tannin, pungent resin.
Xanthoxylum (Prickly Ash).	Xanthoxylum fraxineum.	Fruits.	Volatile oil, resin.
Zedoaria.	Curcuma Zedoaria.	R'zome.	Vol. oil, pungent resin.

Resinous Drugs.

GROUP THREE—RESINOUS DRUGS.

This group includes those vegetable drugs whose virtues are chiefly or wholly due to the presence of an acrid or bitter resin, an acrid fixed oil, or to extractive matter, either associated or not with a volatile oil.

Some few contain glucosides, alkaloids, or other principles, but these are not regarded as possessing any considerable medicinal importance.

Absinthium. — Absinthium, U. S. — Wormwood. leaves and tops of Artemisia absinthium, Linnè. Nat. Ord. Compositæ. Constituents: vol. oil, one per cent., absinthin, tannin, resin, etc. Off. Preparation: Vinum aromaticum.

Pharm. Uses: Tinctura Absinthii and Abstractum Absinthii P. Ger., prepared with diluted alcohol; also largely used in various "Bitters."

Arnica Flowers and Root.—Arnica Flores and Arnica Radix, U. S.—Flowers and Root of Arnica montana Linnè. Nat. Ord., Compositæ. Constituents: vol. oil (root 1 per cent.), inulin, both tasteless and acrid resins, arnicin, etc. Off. Preparations: Tinctura Arnicæ Florum; Extractum Arnicæ Radicis; Extractum Arnicæ Radicis Fluidum; Tinctura Arnicæ Radicis.

Although the root and several preparations of it were made officinal in the U. S. P. '80, the flowers are still chiefly employed.

Asclepias. — Asclepias, U. S. — Pleurisy Root. Root of Asclepias tuberosa, Linnè, Nat. Ord. Asclepiadeceæa. Constituents: bitter principle, resins, tannin, etc.

Pharm. Uses: As infusion in rheumatic affections, and, as its name implies, in pleurisy.

Aspidium.—Aspidium, U. S.—Rhizome of Aspidium felix mas, Schwartz, and of A. marginale, Willd. Nat. Ord., Filices. Constituent: fixed oil, six per cent., filicic acid, filitannic acid, etc. Off. Preparation: Oleoresina Filicis.

Pharm. Uses: For the removal of tapeworm, ten to twenty minims of the oleo-resin, administered upon a fasting stomach, and followed with a purgative.

Azedarach.—Azedarach, U. S.—Root bark of Melia Azedarach, Linnè. Nat. Ord., Meliaceæ. Constituent: bitter resin.

Buchu.—(See Group 2).

Brayera.—Brayera, U. S.—Kousso. Female inflorescence of Brayera anthelmintica, Kunth. Nat. Ord., Rosacæa. Constituents: bitter acrid kousin-resin about six per cent., tannin and tasteless resin. Off. Preparations: Extractum Brayeræ Fluidum; Infusum Brayeræ.

Pharm. Uses: For the removal of tapeworm, either alone or combined with other agents.

American Cannabis.—Cannabis Americana, U. S.—Flowering Herb of Cannabis Sativa, Linnè. Nat. Ord. Urticaceæ. Constituents: volatile oil and resins.

Rarely used in pharmacy; the fruit, known as Hemp Seed, is largely known as a food for birds. It contains a large proportion of fixed oil, and forms an emulsion with water.

Indian Cannabis.—Cannabis Indica, U. S. Flowering tops of a female plant of an East Indian variety of Cannabis sativa, Linnè. Nat. Ord. Urticacæa. Constituents: volatile oil, several resins and alkaloids. Off. Preparations: Extractum Cannabis Indicæ; Extractum Cannabis Indicæ Fluidum; Tinctura Cannabis Indicæ.

Pharm. Uses: Cannabin Tannate is a compound of the active principles with tannic acid, and is said to represent the medicinal virtues of "Indian Hemp."

Caulophyllum. — Caulophyllum, U. S. — Blue Cohosh. Rhizome and rootlets of Caulophyllum thalictroides, Michx. Nat. Ord., Berberidaceæ. Constituents: resins, saponin.

Pharm. Uses: Caulophyllin, a so-ealled resinoid, is prepared by preeipitating an aleoholie tincture in water, washing, drying and powdering the precipitated resin. Owing to the saponin Caulophyilum eontains, due care should be observed in the process of powdering, as it is a violent sternutatory.

Chamomile. — Anthemis, U. S.—Flower heads of Anthemis nobilis, Linnè. Nat. Ord., Compositæ. Constituents: vol. oil, bitter principle, etc.

Pharm. Uses: An ingredient in Bitters for domestic use; also as infusion.

Cimicifuga.—Cimicifuga, U. S.—Black Snakeroot. Rhizome and rootlets of Cimiciguga, racemosa, Elliott. Nat. Ord. Ranunculaceæ. Constituents: resin, acrid principle, and a peculiar acid. Off. Preparations: Extractum Cimicifugæ Fluidum; Tinctura Cimicifugæ.

Pharm. Uses: Cimicifugin, or maerotyn, a resinoid prepared by preeipitating the alcoholic tincture in water, washing, drying and powdering the precipitated resin; also as Decoetion and Infusion, and solid extraet, whieh represents ten times the strength of the erude drug.

Cotton Root Bark.—Gossypii Radicis Cortex, U. S.—Bark of root of Gossypium herbaceum, Linnè, and other species of Gossypium. Nat. Ord., Malvaceæ. Constituents: resins, coloring matter, fixed oil, and a peculiar principle similar to tannin. Off. Preparation: Extractum Gossypii Radicis Corticis Fluidum.

Pharm. Uses: Sometimes in Deeoction and Extraet. Liquid preparations of cotton-root bark are liable to gelatinize, which may be prevented by using strong alcohol as a menstruum.

Cubeb. (See Group 2).

Cypripedium.—Cypripedium, U. S.—Ladies' Slipper. Rhizome and rootlets of Cypripedium pubescens, Willd., and C. parviflorum, Salisbury. Nat. Ord., Orchidaceæ. Constituents: volatile oil, resins, etc. Off. Preparation: Extractum Cypripedii Fluidum.

Eucalyptus. (See Group 2).

Frangula.—Fra gula, U. S.—Buckthorn. Bark of Rhamnus frangula, Linnè. Nat. Ord., Rhamnaceæ. (Should be collected one year, at least before using). Constituents: resin, bitter principle, emodin and frangulin. Off. Preparation: Extractum Frangulæ Fluidum.

Resinous Drugs—(Continued).

Garlic.—Allium, U. S.—Bulb of Allium sativum, Linnè. Nat. Ord., Liliaceæ. Constituents : volatile oil one-fourth per cent., mucilage thirty-five per cent., etc. Off. Preparation : Syrupus Allii.

Ginger. (See Group 2).

Grindelia—Grindelia, U. S.—Leaves and flowering tops of Grindelia robusta, Nuttall. Nat. Ord., Compositæ. Constituents : volatile oil, resin, and bitter extractive. Off. Preparation : Extractum Grindeliæ Fluidum.

Guaiacum Wood.—Guaiaci Lignum, U. S.—Lignum vitæ. Heart-wood of Guaiacum officinale, Linnè. Nat. Ord., Zygophyllaceæ. Constituents : resin and extractive matter.

Pharm Uses : In Decoction as a constituent of Syrup Sarsaparilla comp., and in Species Lignorum P. Ger.

Hamamelis.—Hamamelis, U. S.—Witch Hazel. Leaves of Hamamelis Virginica, Linnè. Nat. Ord., Hamamelaceæ. (Leaves should be collected in autumn while still green). Constituents : tannin and bitter extractive. Off. Preparation : Extractum Hamamelidis Fluidum.

Pharm. Uses : In conjunction with the bark for the preparation of Distilled Extract of Witch Hazel by distillation with water.

Inula.—Inula, U. S.—Elecampane. Root of Inula Helenium, Linnè. Nat. Ord., Compositæ. Constituents : inulin, helenin, bitter extractive, and acrid resin.

Iris.—Iris, U. S.—Blue Flag. Rhizome and rootlets of Iris versicolor, Linnè. Nat. Ord., Iridaceæ. Constituents : volatile oil, acrid resin. Off. Preparations : Extractum Iridis ; Extractum Iridis Fluidum.

Pharm. Uses : Iridin, a resinoid, prepared by precipitating the alcoholic tincture in acidulated water, washing, drying, and powdering the precipitated resin. Iris is also a constituent of Compound Syrup of Stillingia.

Jalap.—Jalapa, U. S.—Tuberous root of Exogonium purga, Bentham. Nat. Ord., Convolvulaceæ. Constituents : resins about fifteen per cent. Off. Preparations : Abstractum Jalapæ ; Pulvis Jalapæ Composita ; Resina Jalapæ.

Pharm Uses : Resin of Jalap or "Jalapin" (prepared in the same way as the foregoing) is soluble in ether to the extent of ten per cent. The insoluble portion is termed convolvulin, and represents the medicinal virtue of Jalap. The U. S. B. directs that Jalap should yield not less than twelve per cent. of resin. The principal use of Jalap is in the form of Abstract in Comp. Cathartic Pills. It is of nearly the same strength as the extract formerly officinal.

Juniper.—Juniperus, U. S.—Fruit of Juniperus communis, Linnè. Nat. Ord., Coniferæ. Constituents ; volatile oil about two per cent., juniperin, resins, and sugar. Off. Preparation : Oleum Juniperi.

Kamala.—Kamala, U. S.—Hairs and glands from capsules of Mallotus Phillipinensis, Mueller Arg., or Rottlera tinctoria, Roxburgh. Nat. Ord., Euphorbiaceæ. Constituents : resins eighty per cent., rottlerin.

Pharm. Uses : As a remedy for Tænia and other intestinal worms, either alone or associated with other agents.

Lappa.—Lappa, U. S.—Burdock. Root of Lappa officinalis, Allioni. Nat. Ord., Compositæ. Constituents : inulin, bitter extractive, mucilage, resin.

Pharm. Uses : A tincture of Burdock fruit, four ounces in a pint of seventy per cent., alcohol, as an internal remedy in certain skin diseases.

Lupulin.—Lupulinum, U. S.—Glandular powder obtained from the strobiles of Humulus lupulus, Linné. Nat. Ord., Urticaceæ. Constituents : volatile oil three per cent., resin, lupamarie acid, etc. Off. Preparations : Extractum Lupulini Fluidum ; Oleó-resina Lupulini.

Pharm. Uses : Chiefly in pills ; made into a mass by the addition of a little ether.

Magnolia. (See Group 2).

Marrubium. (See Group 2).

Matico.—Matico, U. S.—Leaves of Artanthe elongata, Miquel. Nat. Ord., Piperaceæ. Constituents : volatile oil one and a half per cent., pungent resin, artanthic acid, tannin. Off. Preparations : Extractum Matico Fluidum ; Tictura Matico and an unofficinal Infusion.

Matricaria.—Matricaria, U. S.—German Chamomile. Flower heads of Matricaria Chamomilla, Linnè. Nat. Ord., Compositæ. Constituents : volatile oil one-fourth per cent., anthemic acid, anthemidin bitter extractive.

Pharm Uses : As a substitute for English or Roman Chamomile, to which, however, it is said to be inferior.

Mezereum.—Mezereum, U. S.—Bark of Daphne Mezereum, Linnè, and other species of the same genus. Nat. Ord., Thymelaceæ. Constituents : soft acrid resin, daphnin and volatile principle. Off. Preparations : Decoctum Sarsaparillæ compositum ; Extractum Sarsaparillæ compositum fluidum ; Extractum Mezerei ; Extractum Mezerei Fluidum.

Mezereum, when being powdered, produces a very irritating dust ; it may be prevented by sprinkling a little alcohol upon the bark.

Phytolacca Berry.—Phytolaccæ Bacea, U. S.—Poke Berry. Fruit of Phytolacca decandra, Linnè. Nat. Ord., Phytolaccaceæ. Constituents : Acrid principle, sugar, gum, etc.

Phytolacca Root.—Phytolacca Radix, U. S.—Poke Root. Root of Phytolacca decandra, Linnè. Nat. Ord., Phytolaccaceæ. Constituents : Acrid principle, resin, tannin, etc.

Neither are much employed, except by the Eclectic School of Medicine.

Podophyllum.—Podophyllum, U. S.—May Apple. Rhizome and rootlets of Podophyllum peltatum, Linnè. Nat. Ord., Berberidaceæ. Constituents : resins five per cent. Off. Preparations : Abstractum Podophylli ; Extractum Podophylli ; Extractum Podophylli Fluidum ; Resina Podophylli.

Pharm. Uses : Chiefly in the form of resin or Podophyllin (for preparation see Lect. IV) in pills, either alone or combined with other cathartics or agents to modify its action, *i. e.*, extract hyoscyamus.

Resinous Drugs—(Concluded).

Pulsatilla.—Pulsatilla, U. S.—Herb of Anemone Pulsatilla, and A. pratensis, Linn., and of A. patens, variety Nuttalliana, Gray. Nat. Ord., Ranunculaceæ. (Should be collected soon after flowering, carefully dried, and not kept more than one year). Constituent: volatile acrid principle. Preparations: Unofficinal Fluid Extract and Tincture.

Pharm. Uses: The Homœopathic tincture prepared 1 part in 10 of alcohol.

Pumpkin Seed.—Pepo, U. S.—Seeds of Cucurbita Pepo, Linnè. Nat. Ord., Cucurbitaceæ. Constituents: fixed oil forty-four per cent., acrid resin.

Pharm. Uses: Emulsion as a tænifuge: two to four ounces are beaten with some sugar and triturated with water or milk; it should not be strained, as, according to some authorities, its efficiency in expelling the worms is due to the perisperm of the seed, which would be rejected by straining.

Pyrethrum.—Pyrethrum, U. S.—Pellitory. Root of Anacyclus Pyrethrum, De Candolle. Nat. Ord., Compositæ. Constituents: acrid resin, bitter principle, inulin, fixed oil.

Pharm. Uses: Tincture (P. Br., 20 parts in 100 by measure of alcohol), and as an ingredient in Toothache Pills, P. Ger. The ground flowers of Pyrethrum roseum, known as "Persian Insect Powder," for the destruction of insects.

Rosemary. (See Group 2).

Sambucus. (See Group 2).

Savine.—Sabina, U. S.—Leafy tops of Juniperus Sabina, Linnè. Nat. Ord., Coniferæ. Constituents: volatile oil two per cent., resin, tannin. Off. Preparations: Extractum Sabinæ Fluidum.

Scutellaria. (See Group 8).

Serpentaria.—Serpentaria, U. S.—Virginia Snake-root. Rhizome and rootlets of Aristolochia serpentaria, Linnè, and A. reticulata, Nuttall. Nat. Ord., Aristoloehiaceæ. Constituents: volatile oil one-half per cent., bitter principle, tannin. Off. Preparations: Extractum Serpentariæ Fluidum; Tinctura Cinehonæ Compositæ; Tinctura Serpentariæ.

Stillingia.—Stillingia, U. S.—Queen's Root. Root of Stillingia sylvatica, Linnè. Nat. Ord., Euphorbiaceæ. Constituents: pungent acrid resin, fixed oil, tannin, starch. Off. Preparation: Extractum Stillingiæ Fluidum.

Pharm. Uses: In Compound Syrup Stillingia Am. Disp. (Nat. Form). The medicinal value of Stillingia is due chiefly to the oil; since this is insoluble in water the syrup is more or less cloudy. The compound fluid extract should not yield a clear mixture with water, as in that case it must be nearly inert.

Thuja.—Thuja, U. S.—Arbor Vitæ. Fresh tops of Thuja Occidentalis, Linnè. Nat. Ord., Coniferæ. Constituents: volatile oil one per cent., pinipierin, thujin, resin, tannin.

Pharm. Uses: An unofficinal Tincture and Fluid Extract.

Viburnum. (See Group 6).

Viola tricolor. (See Group 6).

Xanthoxylum.—Xanthoxylum, U. S.—Prickly Ash. Bark of Xanthoxylum fraxineum, Willdenow, and of X. Carolinianum, Lambert. Nat. Ord., Rutaeeæ Constituents: bitter principle, acrid oil, both acrid and tasteless resin, tannin. Off. Preparation: Extractum Xanthoxyli Fluidum.

UNOFFICINAL DRUGS—GROUP THREE.

Com. Name.	Bot. Name.	Part Used.	Constituents.
Actæa.	Actæa spicata.	Root.	Acrid principle.
Agaric (white).	(See Group 6).		
Aletris.	Aletris farinosa.	R'zome.	Bitter principle.
Apocynum (Dog's bane)	Apocynum androsæmifolium.	R'zome & Root.	Bitter principle, resin, etc.
Artemisia.	(See Group 2).		
Arum.	Arisæma triphyllum	Corm.	Volatile acrid principle.
Bela.	Aegle Marmelos.	Fruit.	Bitter principle, tannin, vol. oil.
Canella.	(See Group 2).		
Cascara Sagrada.	Rhamnus Purshiana.	Bark.	Resins, tannin, etc.
Chelone.	Chelone glabra.	Herb.	Bitter principle.
Collinsonia.	Collinsonia Canadensis.	R'zome & Root.	Bitter resinous matter.
Coltsfoot.	Tussilago farfara.	Herb.	Bitter principle, tannin, mucilage.
Damiana.	Turnera microphylla	Leaves.	Bitter principle, vol. oil, resin.
Dioscorea.	Dioscorea villosa.	R'zome.	Acrid principle, resin.
Dracontium	Symplocarpus fœtidus.	R'zome.	Acrid principle, resin.
Drosera (Sun dew).	Drosera rotundifolia	Herb.	Acrid resin, etc.
Euphorbia (Flowering).	Euphorbia corollata.	Root.	Acrid resin, etc.
Feverfew.	Pyrethrum Parthenium.	Herb.	Bitter principle, resin, vol. oil.
Gnaphalium	Gnaphalium polycephalum.	Herb.	Bitter principle, vol. oil.
Helianthemum.	Helianthemum Canadense.	Herb.	Bitter principle, tannin.
Heraclum.	Heraclum lanatum.	Roots, leaves & fruits.	Acrid principle, resin and vol. oil.
Hypericum.	Hypericum perforatum.	Herb.	Resin, coloring matter, tannin.
Leonurus.	Leonurus cardiaca.	Herb.	Bitter principle, volatile oil.
Liatris.	Liatris spicata and other species.	Tuber.	Resinous matter, volatile oil.
Lycopus.	Lycopus Virginicus.	Herb.	Bitter principle, volatile oil, tannin.
Menyanthis.	Menyanthis trifoliata.	Leaves.	Acrid principle, Menyanthin.
Milkweed.	Asclepias cornuti.	R'zome.	Bitter principle, Asclepion, resin, tannin.
Myrica.	Myrica cerifera.	Bark.	Acrid resin, Myricinic acid.
Nymphæa.	Nymphæa odorata.	R'zome.	Bitter principle, mucilage, tannin,
Panax (Ginseng).	Panax quinquefolia.	Root.	Resin, panaquilon.
Pimpernel.	(See Group 2).		
Ricinus.	Ricinus communis.	Seed.	Acrid principle, fixed oil.
Sabbatia.	Sabbatia angularis and other species of Sabbatia.	Herb.	Bitter principle, and erythrocentaurin.
Senecio (Life root).	Senecio Aureus.	Herb & Root.	Bitter acrid principle and tannin.
Silphium.	Silphium laciniatum and other species.	Root.	Resins, vol, oil.
Trillium.	Trillium erectum and other species.	R'zome.	Acrid principle, resin, etc.
Triosteum.	Triosteum perfoliatum.	R'zome & Root.	Bitter principle, etc.
Turmeric.	(See Group 2).		
Viscum (Mistletoe).	Viscum album.	Herb.	Bitter resin, salts, and fixed oil.
Wintera.	(See Group 2).		

Astringent Drugs.

GROUP FOUR—ASTRINGENT DRUGS.

This group includes drugs that are used in medicine mainly for their astringent properties. These properties are chiefly due to the presence of tannic or gallic acid, or both.

The astringent principles are often associated with mucilage, and many of them are therefore both demulcent and astringent in their properties.

Castanea.—Castanea, U. S.—Chestnut. Leaves of Castanea vesca, Linnè. Nat. Ord., Cupuliferæ. Should be collected in autumn while still green. Constituents: tannin nine per cent., mucilage, extractive and a little resin. Off. Preparation: Extractum Castaneæ Fluidum.

Pharm. Uses: Infusion, one ounce to the pint, as a remedy for whooping cough.

Catechu.—Catechu, U. S.—Extract obtained from wood of Acacia Catechu, Willd. Nat. Ord., Leguminosæ. Off. Preparations: Tinctura Catechu Comp.; Trochisci Catechu.

The principal constituents are:

Catechutannic acid, from 25 to 50 per cent., soluble in cold water, giving an olive brown coloration with ferric salts.

Catechin, from 15 to 30 per cent., saluble in ether and alcohol, but slightly in water; produces a green color with ferric salts. It yields *Pyrocatechin* upon dry distillation.

Protocatechnic acid is formed by the action of potassa upon catechu and similar resinous tannins.

Pharm. Uses: In Compound Powders and as a Dye-Stuff. Pale catechu or Gambir is mostly used as a dye.

Cherry, Wild.—(See Group 6).

Geranium.—Geranium, U. S.—Cranesbill. Rhizome of Geranium maculatum, Linnè. Nat. Ord., Geraninaceæ. Constituents: tannin fifteen per cent. Off. Preparations: Extractum Geranii Fluidum and an unofficinal Infusion.

Krameria.—Krameria, U. S.—Rhatany—Root of Krameria triandra, Ruiz and Pavon, and K. tomentosa, St. Hilaire. Nat. Ord., Krameriaceæ. Constituents: kramerio-tannic acid about ten per cent., resembles catechin in imparting a green color to ferric salts and in forming pyrocatechin by dry distillation; and red coloring matter. Off. Preparations: Extractum Krameriæ; Extractum Krameriæ Fluidum; Tinctura Krameriæ.

Nutgall.—Galla, U. S.—Excrescences on Quercus lusitanica, var. infectoria, De Candolle, caused by sting of female of Cynips Gallæ tinctoriæ, Olivier. Nat. Ord., Hymenoptera of the class Insecta. Constituents: tannic acid about sixty per cent., and gallic acid two or three per cent. Off. Preparations: Tinctura Gallæ; Unguentum Gallæ.

Pharm. Uses: In the preparation of tannic and gallic acids and inks.

Hamamelis. (See Group 3).

Hæmatoxylon. (See Group 1).

Matico. (See Group 3).

Some of the drugs referred to in this group as wild cherry, and the three above mentioned, are usually classed as astringent; but as they contain other active constituents not astringent, it was deemed best to treat of them as indicated.

Of Hamamelis and Hæmatoxylon, it may be said that the acids to which their astringency is due, differ quite considerably from the tannic and gallic acids, which are the chief active principle in the drugs included in this group.

White Oak.—Quercus alba, U. S.—Bark of Quercus alba, Linnè. Nat. Ord., Cupuliferæ. Constituents: tannin or quercitannic acid 6 to 11 per cent., producing a blue-black coloration with ferric salts, but not identical with gallo-tannic acid; resin and coloring matter.

Pharm. Uses: Chiefly in tanning leather.

Pomegranate. (See Group 7).

Prinos.—Prinos, U. S.—Black Alder. Bark of Prinos verticillatus, Linnè. (Ilex verticillata, Gray). Nat. Ord., Aquifoliaceæ. Constituents: resin, bitter principle, tannin.

Rubus.—Rubus, U. S.—Blackberry. Bark of root of Rubus villosus, Aiton. R. Canadensis, Linnè, and R. trivialis, Michaux. Not. Ord., Rosaceæ. Constituents: tannin ten per cent. Off. Preparations: Extractum Rubi Fluidum; Syrupus Rubi.

Pharm. Uses: In decoction and infusion. From the fermented juice of the berry, Blackberry wine and brandy, useful in summer complaints.

Rumex.—Rumex, U. S.—Yellow dock. Root of Rumex crispus, Linnè and other species of Rumex. Nat. Ord., Polygonaceæ. Constituents: tannin, chrysophan, chrysophanic acid, mucilage. Preparation: Extractum Rumicis Fluidum.

Pharm. Uses: Decoction, one ounce to the pint, also in Compound Syrup of Stillingia and various preparations of the American Dispensatory.

UNOFFICINAL DRUGS—GROUP FOUR.

Com. Name.	Bot. Name.	Part Used.	Constituents
Agrimonia.	Agrimonia eupatoria	Herb.	Tannin 5%.
Alder.	Alnus serrulata.	Bark.	Tannin 4%.
Areca.	Areca catechu.	Seed.	Tannin 15%, fixed oil.
Avens.	Geum rivale.	R'zome.	Tannin, bitter principle.
Bistort.	Polygonum bistorta.	R'zome.	Tannin, etc.
Comfrey.	Symphytum officinale.	Root.	Mucilage, tannin.
Diospyros, or Persimmon.	Diospyros Virginiana.	Fruit & Bark	Tannin, sugar, etc.
Hepatica.	Hepatica triloba and " acutiloba.	Herb.	Tannin, mucilage.
Heuchera. (Alumroot).	Heuchera Americana.	Root.	Tannin 20%.
Oenotheria. (Evening Primrose)	Oenotheria biennis.	Herb.	Tannin, mucilage.
Plantain.	Plantago lanceolata " major.	Herb.	Tannin and bitter principle.
Pulmonar'a.	Pulmonaria officinalis.	Herb.	Tannin, mucilage, resin.
Spiræa. (Hardhack).	Spiræa tomentosa.	Flowering tops.	Tannin, bitter principle.
Statice.	Statice limonium var. Carolinianum.	Root.	Tannin, mucilage.
Sumach.	Rhus glabra.	Bark.	Tannin, resinous matter.
Tormentil.	Potentilla tormentilla.	R'zome.	Tannin, kinovic acid.

Questions on Lecture VI.—Series 8, 1891.

1. Mention the Characteristics of Resins.
2. What *relations* do the Resins sustain to Volatile Oils?
3. What kind of Resins are saponifiable?
4. In what officinal preparations are volatile oils the chief ingredients?
5. What are the chief pharmaceutical uses of the Resins?
6. Why is Colophony employed in the manufacture of Soap?
7. Is Gum Myrrh a Resin, Oleo-Resin, Gum-Resin, or Gum? Give reason for your answer.
8. Explain the difference between Turpentine, Oil of Turpentine and "Rosin."
9. Define an Oleo-Resin.
10. What Resin possesses strong hydragogue cathartic properties?
11. What are the common medicinal properties of the Balsams?
12. What are the principal constituents of Fixed Oils?
13. What are the Fixed Oils chemically?
14. Mention the properties of Fixed Oils.
15. What other Fixed Oil is most commonly substituted for Almond and Olive Oils?
16. What Animal Oils are officinal in the U. S. P.?
17. What advantage does Petrolatum have over Lard as an ointment vehicle?
18. What are the melting points of officinal Petrolatum? Which is the preferable variety?
19. State the difference between a Fixed Oil and a Soap.
20. Give formula for a four-ounce Emulsion, containing 1 ounce of Cod Liver Oil.
21. What is the difference in derivation between Adeps Lanæ and Adeps Suillus?

IMPORTANT.

Students will please reply to the above questions on *letter-size* paper, *in ink*, writing only on *one* side of the paper, and forward promptly to the director, signed. In answering, it is *not* necessary to repeat the question itself, but only the *number* of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

☞In order to secure prompt attention all the rules of the "Important Notice" must be complied with.

Director.

National Institute of Pharmacy.

LECTURES, SEMI-MONTHLY, BY MAIL.
C. S. HALLBERG, Ph. G., *Director.*

DEPARTMENT OF EXAMINATIONS.

CHICAGO, Sept, 1891.

C. F. Carpenter, East Hampton, Conn.

Upon Questions on Lecture VII, Series 7, we transmit the following printed answers for further comparison and study:

1. According to origin into two Groups; according to nature of Constituents into eight Groups. Refer to page 69.

2. It affords the only correct index as to proper method of Extraction and pharmaceutical treatment in general.

3. Refer to page 31.

4. Refer to page 75, par. 1.

5. Refer to page 69.

6. Almond, Flaxseed, and Lycopodium.

X 7. To avoid the undesirable Starch which the drug contains in considerable proportion,

8. Asparagus, Potato, Celery, Pea, Bean, etc.

9. Manna.

10. Volatile Oil and Resin chiefly.

11. (*a*) African and Jamaica. (*b*) The Jamaica.

12. Not without sacrificing valuable medicinal constituents.

13. Tannin of the Cinnamon forms insoluble combinations with active principles of the Digitalis.

X 14. The "white" contains a bitter principle which would prove deleterious to the flavor of preparations of the peel.

15. Resinoids or Eclectic "Concentrations."

16. Frangula.

17. Aspidium, Brayera, Kamala, and Pepo.

18. Dilute alcohol associated with glycerin.

19. Tannin.

20. By means of strong Alcohol to prevent gelatinization.

21. Albumin, Gelatin, Metallic and Alkaloidal salts, etc.

22. It yields Gallic Acid; other tannins do not.

23. By reason of the Tannin which of it contains a considerable proportion.

Your rating on answers to Lecture 7 *is* 91 *per cent.*

The abbreviations "P.," "Col." and Par.," are used to indicate "page," "column," and "paragraph," respectively.

In rating the answers, your *general understanding of the subjects* and the *appearance of your paper*, are also taken into consideration.

☞ The above questions should be *carefully reviewed* upon receipt of corrections. If questions to any other Lectures remain unanswered, please send them in at once.

THE DIRECTOR.

Always continue to answer in the regular order without waiting for delayed observations. Corrections are always forwarded as promptly as possible.

☞ NOTICE.—Do not fail to write your name, full address and CLASS page 627, at the TOP of the first page of your answers.
In all correspondence the CLASS page must be stated in order to insure prompt attention.

Refrigerant Drugs—Glucosides.

REFRIGERANT DRUGS—GROUP FIVE.

This group includes those drugs whose virtues chiefly depend on the presence of such organic acids as citric, malic and tartaric acids. Many of them possess mildly laxative properties.

Cassia Fistula.—Cassia Fistula, U. S.—Fruit of Cassia Fistula, Linnè. Nat. Ord., Leguminosæ. Constituents: sugar, musilage, pectin, fruit acids. Off. Preparation: Confectio Sennæ.

Pharm. Uses: The pulp is prepared by treating the cassia with water, freeing the mixture from the seeds and woody portion by straining and evaporating the liquid; yield, about 30 per cent.

Lemon Juice.—Limonis Succus, U. S.—Fresh juice of ripe fruit of Citrus Limonium, Risso. Nat. Ord., Aurantiaceæ. Constituents: citric acid from 7 to 10 per cent. and malic acid and gum. Off. Preparations: Mistura Potassii Citratis; Syrupus Limonis.

Lemon juice is liable to become moldy or otherwise unfit for use. It may be preserved by precipitating the gum by the addition to the juice of one-half its weight of alcohol, the clear portion heated to expel the alcohol, and bottled while hot.

Raspberry.—Rubus Idæus, U. S.—Fruit of Rubus Idæus: Linnè. Nat. Ord., Rosaceæ. Constituents: trace of volatile oil, citric and malic acids, pectin, glucose, coloring matters. Off. Preparation: Syrupus Rubi Idæi.

In the preparation of Raspberry Syrup, the crushed berries are allowed to stand for about 36 hours, so as to undergo a slight fermentation. The expressed juice is then strained, heated to boiling to coagulate albuminous matter, strained, and the sugar dissolved in the liquid by a gentle heat.

Rhus Glabra.—Rhus glabra, U. S.—Smooth Sumach. Fruit of Rhus glabra, Linnè. Nat. Ord., Anacardiaceæ. Constituents: acid calcium and potassium malates, tannin, coloring matter. Preparation: Extractum Rhus Glabræ Fluidum.

Pharm. Uses: Infusion or decoction as a gargle in sore throat.

Tamarinds.—Tamarindus, U. S.—Preserved pulp of fruit of Tamarindus Indica, Linnè. Nat. Ord., Leguminosæ. Constituents: citrates, malates, tartrates, acetates; also sugar, pectin, tannin. Off. Preparation: Confectio Sennæ.

Pharm. Uses: The pulp is prepared by treating tamarinds, with water, expressing and straining the expressed liquid, then evaporating to the consistency of a pulp or a very soft extract.

GLUCOSIDAL DRUGS—GROUP SIX.

This group includes drugs whose virtues depend largely or wholly on the presence of glucosides and neutral principles, or on peculiar organic acids.

Some drugs are included under this head whose active principles have not yet been isolated, when there is good reason to believe such active principles are present in the drug.

Among the drugs included in the glucosidal group are a few which possess very peculiar characteristics, and are classed by some authors as *reactionary drugs.*

These contain two or more complex principles, one being an albuminous ferment, coagulable and destroyed by heat, but rendered active in the presence of water; the other, a still more complex principle, possessing glucosidal or feebly alkaloidal properties, and decomposed by the action of the ferment, in the presence of water, into various compounds, frequently volatile, and quite active medicinally.

Definition.—The term *glucoside* is applied to those organic principles which are readily resolvable into *glucose* and another organic principle, either by the action of mineral acids, of alkalies, or of ferments.

They are nearly all *ternary* compounds, that is, composed of Carbon, Hydrogen and Oxygen, while one is *quaternary* or nitrogenized, viz: Amygdalin $C_{26}H_{27}NO_{11}+3H_2O$, and one is *sulphureted* or complex, viz.: Sulphosinapisin $C_{16}H_{23}NO_5H_2SO_4+2H_2O$.

They possess either neutral or acid properties, and occasionally form salts or crystalline compounds; some few are soluble in water, but the greater number are nearly insoluble in water, though readily soluble in alcohol.

The English ending *in*, Latin *inum*, has now been generally adopted to distinguish them from the alkaloids (*ina*), and is officinally recognized.

Some of the peculiar acids found in organic drugs might be classed as glucosides, and are so classed by some authorities, because they are separable into glucose and another organic principle, and they are treated of here in that connection. The Neutral Principles are also included in this group, because in the present state of our knowledge of the organic principles it is very difficult to draw a line between these exceedingly complex substances.

The officinal Glucosides or Neutral Principles are:

Chrysarobin.—Chrysarobinum, U. S.—A mixture of proximate principles extracted from Goa powder, a substance occurring in the trunk of Araroba. It is also found in Rheum palmatum, Cassia acutifolia, Rumex crispus, and several Lichens. Off. Preparation: Unguentum Chrysarobini.

Picrotoxin.—Picrotoxinum, U. S.—Prepared from the Seeds of Anamirta paniculata, Colebrooke. Nat. Ord., Menispermaceæ.

Salicin.—Salicinum, U. S.—Prepared from the Bark of Salix helix, Linnè., and other species of Salix. Nat. Ord., Salicaceæ.

Uses: As a substitute for quinine.

Santonin.—Santoninum, U. S.—Prepared from Levant Wormseed, Artemisia maritima var. Stechmanniana. Nat. Ord., Compositæ.

Santonin is really an acid, forming salts with alkalies, Sodium santoninate, etc. Off. Preparation: Trochisci Sodii Santoninatis.

For a full description of these see the U. S. P. and the Dispensatories.

Reactionary.—Glucosidal Drugs.

The following Reactionary Drugs are officinal :

Bitter Almond.—Amydala amara, U. S.—Seed of Amygdala communis, var. Amara, De Candolle. Nat. Ord., Rosaceæ. Constituents : fixed oil about 45 per cent., amygdalin, emulsin, mucilage, sugar, etc. Off. Preparation : Syrupus Amygdalæ.

When bitter almonds are brought into contact with water, the ferment emulsin decomposes the glucoside amygdalin into hydrocyanic acid, oil of bitter almond and sugar.

Pharm. Uses : Chiefly for preparing oil of bitter almond.

Wild Cherry.—Prunus Virginiana, U. S.—Bark of Prunus Serotina, Erhart. Nat. Ord., Rosaceæ. Constituents : bitter principle, tannin, amygdalin, and emulsin. Off. Preparations : Extractum Pruni Virginianæ Fluidum ; Infusum Pruni Virginianæ ; Syrupus Pruni Virginianæ.

Wild cherry bark should be collected in the month of October, as it then yields the greatest proportion of hydrocyanic acid ; the thick, corky layer frequently found on old bark, should be removed. When treated with water, hydrocyanic acid is produced by the action of the emulsin upon amygdalin, similarly to the reaction of these principles in bitter almonds. The power of the ferment is destroyed by heat, hence the necessity of extracting the bark with cold solvents, preferably water alone. Since the active consituents, the hydrocyanic acid and probably also an oil identical with that from the bitter almond, are very volatile, vessels in which the maceration is conducted, in a preparation of the syrup, etc., must be tightly covered.

Black Mustard.—Sinapis Nigra, U. S.—Seed of Sinapis nigra, Linnè. Nat. Ord., Cruciferæ. Constituents : fixed oil 25 per cent., myrosin, sinigrin, giving rise to volatile oil. Off. Preparation : Charta Sinapis.

Pharm. Uses : In coarse powder, or ground, for the preparation of cataplasm, mixed with cold water. Black mustard is more irritant than the white, and is therefore frequently mixed with the latter when used to produce blister. Mustard seed oil is obtained by expression between hot plates of iron.

White Mustard.—Sinapis Alba, U. S.—Seed of Sinapis alba, Linnè. Nat. Ord., Cruciferæ. Constituents : fixed oil, 20 to 25 per cent.; sinalbin and myrosin giving rise to volatile oil.

Pharm. Uses : Similar to those of Black Mustard.

Both black and white mustard contain a ferment *myrosin*, and each a glucoside termed respectively *sinigrin* and *sinalbin*. In the presence of water these substances are decomposed by the myrosin, forming volatile compounds, to which the acrid taste and irritant action of both kinds of mustards are due. Sinigrin, the principle of black mustard, is by this reaction transformed into sulphocyanide of allyl or volatile oil of mustard, an exceedingly irritating, and, when taken internally, poisonous substance ; it is used in Spiritus Saponis, U. S. Some acid potassium sulphate and sugar are also formed.

Sinalbin, the principle contained in white mustard, also termed sulphocyanide of sinapin, is decomposed by the action of myrosin, in the presence of water, into sulphate of sinapin and sulphocyanide of acrinyl, a thick, non-volatile oil, possessing vesicating properties. The base of the other compound, sinapin, is supposed to be an alkaloid, but has not yet been isolated.

For further information concerning these interesting drugs, see the Dispensatories, or Remington's or Parrish's Pharmacy.

GLUCOSIDAL DRUGS.

Aloes.—Aloe, U. S.—Inspissated juice of leaves of Aloe Socotrina, Lamarck. Nat. Ord., Liliaceæ. Constituents ; aloin, resin, vol. oil (small quantity). Off. Preparations : Aloe purificata ; Extractum Aloes Aquosum ; Extractum Colocynthidis comp.; Pilulæ Aloes ; Pil. Aloes et Asafœtidæ ; Pil. Aloes et Ferri ; Pil. Aloes et Mastiches ; Pil. Rhei comp.; Tinctura Aloes ; Tinct. Aloes et Myrrhæ ; Tinctura Benzoini comp.; Vinum Aloes.

Three different kinds of Aloes occur in commerce, viz.: Barbadoes, Cape, and Socotrin or Zanzibar, obtained from various species of the Aloe plant. Of these Socotrin aloes is regarded as containing the greatest proportion of active principle—aloin—as well as being less harsh in its action than the other varieties ; it is the only kind officinal.

Pharm. Uses : Chiefly as purified Aloes, prepared by fusing crude aloes upon a water-bath and straining it through a fine sieve, previously dipped in boiling water. The aloes is kept in a semi-liquid condition by the addition of fifteen per cent. of alcohol, which is volatilized in the evaporation of the strained liquid to brittleness. It yields a light golden-yellow powder, and is an ingredient in many unofficinal pills, etc., and in Comp. Powder of Aloes and Canella, "Hiera Picra," formerly officinal, prepared as follows : Aloes, Soc., four parts ; Canella, one part ; both in fine powder and thoroughly mixed.

Apocynum.—Apocynum, U. S.—Canadian Hemp. Root of Apocynum Cannabinum, Linnè. Nat. Ord., Apocynaceæ. Constituents : apocynin, apocynum, tannin, bitter extractive.

Pharm. Uses : In preparing a fluid extract, with diluted alcohol as a menstruum, and in Apocynin, a resinoid, the preparation of which has not been published.

Araroba.—Goa Powder. Powder obtained from cavities in trunk of Andira Araroba, Aguaiar. Nat. Ord., Leguminosæ. Constituents : resin, gum, chrysarobin. Off. Preparations : Chrysarobinum ; Unguentum Chrysarobini.

Pharm. Uses : As a source of chrysarobin, of which it contains about eighty per cent., and in ointments.

Bryonia.—Bryonia, U. S.—Bryony. Root of Bryonia alba and B. dioica, Linnè. Nat. Ord., Cucurbitaceæ. Constituents : bryonin (glucoside). Off. Preparations : Tinctura Bryoniæ.

Pharm. Uses : Chiefly as homœopathic tincture. A fluid extract is made with alcohol of 85 per cent.

Calendula.—Calendula, U. S.—Marigold. Fresh flowering herb of Calendula officinalis, Linnè. Nat. Ord., Compositæ. Constituents : vol. oil (trace), calendulin, bitter principle. Off. Preparation : Tinctura Calendulæ.

Pharm. Uses : Chiefly as a substitute for arnica in the form of tincture and infusion, as an application for sprains and bruises.

Calumba.—Calumba, U. S.—Columbo. Root of Jatcorrhiza Calumba, Miers. Nat. Ord., Menispermaceæ. Constituents : columbin, berberine, columbic acid. Off. Preparations : Extractum Calumbæ Fluidum ; Tinctura Calumbæ.

Pharm. Uses : As infusion, and in powder associated with other tonics.

Glucosidal Drugs—(Continued).

Cascarilla. (See Group 2).

Caulophyllum. (See Group 3).

Cetraria. (See Group 1).

Dulcamara. — Dulcamara, U. S. — Bitter-sweet. Young branches of Solanum dulcamara, Linnè. Nat. Ord., Solanaceæ. Constituents: resin, dulcamarin (glucoside), etc. Off. Preparation: Extractum Dulcamaræ Fluidum.

Pharm. Uses: As infusion and Decoction.

Capsicum.—Capsicum, U. S.—Cayenne Pepper. Fruit of Capsicum fastigiatum, Blume. Nat. Ord. Solanaceæ. Constituents: volatile oil, capsaicin, resin, etc. Off. Preparations: Extractum Capsici Fluidum; Oleoresina Capsici; Tinctura Capsici.

Pharm. Uses: Chiefly in the powdered form as a condiment; also as a rubefacient in Liniments and Plasters.

Chimaphila. — Chimaphila, U. S. — Pipsissewa. Leaves of Chimaphila umbellata, Nuttall. Nat. Ord., Ericaceæ. Constituents: chimaphilin, arbutin, ericolin, urson, tannin, etc. Off. Preparation: Extractum Chimaphilæ Fluidum.

Pharm. Uses: As infusion and as an ingredient in Syrup Stillingia Comp. Am. Disp.

Chirata—Chirata, U. S.—Entire plant of Ophelia Chirata, Griesbach. Nat. Ord., Gentianaceæ. Constituents: chiratin (glucoside) and ophelic acid. Off. Preparations: Extractum Chiratæ Fluidum; Tinctura Chiratæ.

Pharm. Uses: Sometimes as infusion, now seldom used, being superseded by gentian and other less costly bitters.

Cloves. (See Group 2).

Colocynth.—Colocynthis, U. S.—Fruit of Citrullus Colocynthis, Schrader. Nat. Ord., Cucurbitaceæ. Constituents: colocynthin, resin, fixed oil, etc. Off. Preparations: Extractum Colocynthidis; Extractum Colocynthidis comp.

Pharm. Uses: Chiefly for the preparation of the extract, and in powdered form in combination with less drastic purgatives. The fruit should be deprived of the seeds previous to use, because they contain a considerable quantity of fixed oil which is undesirable in the preparations. The percentage yield of extract varies considerably, but averages about 17 per cent.

Cornus.—Cornus, U. S.—Dogwood. Root bark of Cornus Florida, Linnè. Nat. Ord., Cornaceæ. Constituents: cornin, tannin, resin. Off. Preparation: Extractum Cornus Fluidum.

Pharm. Uses: As a domestic bitter and tonic in decoction or powder.

Cubeb. (See Group 2).

Digitalis.—Digitalis, U. S.—Foxglove. Leaves of Digitalis purpurea, Linn`. Nat. Ord., Scrophulariaecæ. Constituents: digitalin, digitoxin and resin. Off. Preparations: Abstractum Digitalis; Extractum Digitalis; Extractum Digitalis Fluidum; Infusum Digitalis; Tinctura Digitalis.

The so-called "Digitalin" of commerce is a mixture of the various active principles, and should not be confounded with the pure active principle, the *Digitaline,* which possesses much greater strength.

Ergot.—Ergota, U. S.—Ergot of Rye. Sclerotium of Claviceps purpurea, Tulasne. Nat. Ord., Pyrenomycetes of the class Carposporæ, a fungi replacing the grain of common rye, Sceale cereale, Linnè. Constituents: sclerotic acid, scleromucin, sclererythrin, fixed oil, etc. Off. Preparations: Extractum Ergotæ; Extractum Ergotæ Fluidum; Vinum Ergotæ.

Some doubt yet exists as to what the medicinally valuable principles of Ergot really are. The fact is conceded, however, that whether they be glucosidal, alkaloidal, or both, or whether it owes its value to a peculiar acid, the desirable principles are more soluble in water than in alcohol, and that, therefore, preparations made with aqueous menstrua are preferable to those with alcoholic menstrua.

Ergot contains from twenty-five to thirty-five per cent. of a non-drying fixed oil more soluble in strongly alcoholic menstrua than in those more aqueous; and since this oil is very undesirable, its presence in the preparations is best avoided through the use of diluted alcohol (or still weaker, 40 per cent.) for exhausting the drug. The use of glycerin is for the same reason objectionable.

Pharm. Uses: "Ergotin," a misnomer for a sort of extract supposed to represent the medicinal value of the drug. It varies in composition according to the process employed in its preparation, and may contain the principles soluble in alcohol only (Wigger's); those soluble in weaker (seventy-five per cent.) alcohol (Bonjean's); or those soluble in twenty per cent. alcohol, the fixed oil having been removed (Hallberg in Am. Jour. Pharm., 1882).

The officinal extract prepared by evaporating the fluid extract to one-fifth of its volume is a more reliable preparation than the two first mentioned, although containing a considerable quantity of fixed oil, objectionable when dispensed in pills, which the last mentioned (Hallberg's) is free from.

Powdered Ergot quickly becomes rancid, and thus unfit for use; it may be prevented by depriving the Ergot of its fixed oil with ether or petroleum-benzin. (See Pulv. Ergotæ purificat. Pharmacopœia Germanica or National Dispensatory).

Eunonymus.—Eunonymus, U. S.—Wahoo. Bark of Eunonymus atropurpureus, Jaquin. Nat. Ord., Celastraceæ. Constituents: eunonymin, resin, asparagin, etc. Off. Preparation: Extractum Eunonymi.

Pharm. Uses: Euonymin, a resinoid prepared by precipitating the alcoholic tincture in water; it is unreliable, and the extract may be substituted for it with advantage.

Eupatorium. — Eupatorium, U. S. — Boneset. Leaves and flowering tops of Eupatorium perfoliatum, Linnè. Nat. Ord., Compositæ. Constituents: eupatorin (glucoside), volatile oil, resin. Off. Preparation: Extractum Eupatorii Fluidum; and Infusion unofficinal.

Frangula. (See Group 3).

Gurana. (See Group 8).

Juglans.—Juglans, U. S.—Butternut. Inner bark of root of Juglans cinerea, Linnè. Nat. Ord., Juglandaceæ. (Should be collected in autumn or very early spring). Constituents: nucin, tannin, fixed oil and volatile oil (trace). Off. Preparation: Extractum Juglandis.

Pharm. Uses: Juglandin, a resinoid, prepared by the general formula for this class; the officinal extract is a more reliable and efficient preparation.

Juniper. (See Group 3).

Glucosidal Drugs—(Continued).

Glycyrrhiza.—Glycyrrhiza, U. S.—Liquorice Root. Root of Glycyrrhiza glabra, Linnè. Nat. Ord., Leguminosæ. Constituents: glycyrrhizin, glycyramarin, sugar, asparagin and resin. Off. Preparations; Extractum Glycyrrhizæ Fluidum; Extractum Glycyrrhizæ Purum; Glycyrrhizinum Ammoniatum; Pulvis Glycyrrhizæ compositus; Extractum Sarsaparillæ comp; Massa Hydrargyri; Pilulæ Ferri Iodidi; Syrupus Sarsaparillæ comp; Tinctura Rhei dulcis.

Pharm. Uses: The purified extract, prepared by exhausting the root with ammoniated water and evaporating to the consistency of a soft extract, is entirely soluble in water, and therefore superior to the commercial extract of licorice in the preparation of Brown Mixture (Mistura Glycyrrhizæ comp.) A Syrup and Elixir are also prepared from it. For formulas see National Formulary.

Glycyrrhizin is obtained by precipitating the ammoniacal liquid extract from the root with sulphuric acid and dissolving the precipitate, first carefully washed, in ammonia water, then evaporated by a gentle heat until of syrupy consistence, which is spread upon plates of glass to dry, and finally obtained as scales.

The commercial powdered extract contains a large proportion of starch and other inert matter as adulterants to retain it in the pulverulent form. The powdered root is also frequently adulterated or obtained from inferior specimens of the root. Licorice and its various preparations, owing to their peculiar sweet taste, is largely employed as adjuvant to nauseous mixtures and to disguise the taste of bitter medicines, as of quinine. It is the most effective ingredient in Compound Elixir Taraxacum.

Kamala. (See Group 3).

Leptandra.—Leptandra, U. S.—"Culver's Root." Rhizome and rootlets of Leptandra Virginica, Nuttall (Veronica Virginica, Linnè). Nat. Ord., Scrophulariaceæ. Constituents; leptandrin, resin, saponin, etc. Off. Preparations: Extractum Leptandræ; Extractum Leptandræ Fluidum.

Pharm. Uses: "Leptandrin," a resinoid, prepared by precipitatiug the alcoholic tincture in water and drying the precipitated resin. The remaining clear liquid is boiled and sulphuric acid added until it ceases to produce a precipitate, the clear liquid is rejected, the precipitate washed to free it from sulphuric acid, dried, mixed with the resin previously obtained, and powdered. This preparation represeuts all the virtues of Leptandra.

Pansy.—Viola Tricolor, U. S.—Uncultivated flowering herb of Viola tricolor, Linnè. Nat. Ord., Violaceæ. Constituents: bitter principle, resin, salicylic acid.

Quillaja.—Quillaia, U. S.—Soap Bark. Bark of Quillaia Saponaria, Molina. Nat. Ord., Rosaceæ. Constituent: saponin.

Pharm. Uses: A tincture is prepared from one part of the bark to five parts of diluted alcohol; its principal use is to impart the quality of frothing to Soda Water Syrups; it is sometimes used in Emulsions.

Quassia.—Quassia, U. S.—Wood of Picræna excelsa, Lindley (Quassia excelsa, Schwartz). Nat. Ord., Simarubaceæ. Constituents: quassin, resin. Off. Preparations: Extractum Quassiæ; Extractum Quassiæ Fluidum; Tinctura Quassiæ.

Pharm. Uses: As an ingredient in Bitters. and as Infusion, often in conjunction with other bitters.

Phytolacca. (See Group 3).

Rhubarb.—Rheum, U. S.—Root of Rheum officinale, Baillou, and other as yet undetermined species of Rheum. Nat. Ord., Polygonaceæ. Constituents: chrysophan, chrysophanic acid, erythroretin, emodin, phæoretin, aporetin, tannin. Off. Preparations: Extractum Rhei; Extractum Rhei Fluidum; Pilulæ Rhei; Pilulæ Rhei compositæ; Pulvis Rhei compositus; Syrupus Rhei; Tinctura Rhei; Tinctura Rhei Aromatica; Tinctura Rhei Dulcis; Vinum Rhei.

Pharm. Uses: In the powdered form, which should be obtained from choice specimens of the root; the powder of commerce being frequently prepared from decayed and otherwise inferior roots. When Rhubarb in small square pieces is subjected to a heat of about 250° F. (roasted), the principles to which its cathartic action is owing are modified or destroyed, so that it becomes astringent in its properties.

Rhus Toxicodendron.—Rhus Toxicodendron, U. S.—Poison Ivy or Poison Oak. Fresh leaves of Rhus Toxicodendron, Michaux. Nat. Ord., Anacardiaceæ. Constituents: toxicodendric acid, tannin, etc.

Pharm. Uses: A Tincture, to be prepared from the fresh leaves, according to the formula for Tincturæ Herbarum recentis, U. S. P., chiefly used in homœopathy.

Rumex. (See Group 4).

Santonica.—Santonica, U. S.—Levant Wormseed. Unexpanded flower heads of Artemisia maritima, var. Stechmanniana, Besser. Nat. Ord., Compositæ. Constituents: santonin one and a half to two per cent., volatile oil one per cent.

Pharm. Uses: Wormseed, covered with sugar; in powder; often in conjunction with calomel triturated with sugar; and in decoction or infusion, as anthelmintic. Its active principle, Santonin, in the form of troches, containing one grain in each, is more eligible and effective. The principal use of the drug is in the preparation of Santonin, many thousands of pounds being produced annually.

Salix.—Salix, U. S.—Willow. Bark of Salix alba, Linnè, and of other species of Salix. Nat. Ord., Salicaceæ. Constituents: salicin, tannin.

Pharm. Uses: An unofficinal Fluid Extract, and for the preparation of Salicin.

Sarsaparilla.—Sarsaparilla, U. S.—Root of Smilax officinalis, Kunth, S. medica, Schlechtendal and Chamisso, and other species of Smilax. Nat. Ord., Smilaceæ. Constituents: parillin, resin, etc. Off. Preparations: Decoctum Sarsaparillæ compositum; Extractum Sarsaparillæ compositum Fluidum; Syrupus Sarsaparillæ compositus.

Four kinds of Sarsaparilla occur in commerce, viz.: Honduras, Rio Negro, Mexican and Jamaica. Of these, the Honduras variety is considered the best, although the Jamaica is the only kiud officinal in the P. Br., and with others, again, the Mexican is regarded as superior. It is quite likely that Sarsaparilla, no matter what kind, possesses but little medicinal value, and is an ingredient of only secoudary importance, in many of the preparations that bear its name.

Glucosidal Drugs—(Concluded).

Senega.—Senega, U. S.—Root of Polygala Senega, Linnè. Nat. Ord., Polygalaceæ. Constituents: senegin, polygalin, or polygalic acid, fixed oil. Off. Preparations: Abstractum Senegæ; Extractum Senegæ Fluidum; Syrupus Scillæ compositus.

Senega is an exceedingly active drug, and care should be used in dispensing it. Its quality of frothing, when in aqueous mixtures, is owing to the polygalin, a substance similar to saponin.

Pharm. Uses: Infusion and as Extract, formerly officinal, as a substitute for which the abstract has been recommended. Owing to the large percentage of Extract obtained from the drug the preparation of the abstract in the powdered form is impracticable.

Senna.—Senna, U. S.—Leaflets of Cassia acutifolia, Delisle, and C. elongata Lemaire-Lisaicourt. Nat. Ord., Leguminosæ. Constituents: cathartic acid, sennacrol (a bitter principle), sennit. Off. Preparations: Confectio Sennæ; Extractum Sennæ Fluidum; Infusum Sennæ compositum; Pulvis Glycyrrhizæ compositus; Syrupus Sarsaparillæ compositus; Syrupus Sennæ.

The Pharmacopœia recognizes as Senna the leaves from two species of Cassia, of which that from C. acutifolia is known in commerce as Alexandria Senna, and that from C. elongata as India Senna, two varieties of which are known, viz.: Tinnevelly and East India or Bombay.

Alexandria Senna is probably more active than the India Sennas (Tinnevelly and Bombay), but not presenting as fine an appearance as Tinnevelly, the latter is usually preferred.

Pharm. Uses: By treating Senna with strong alcohol the principles to which the griping qualities are due are extracted, without in the least impairing its cathartic properties, when the drug, after being dried is easily exhausted with water or weak alcohol.

The drug may also be extracted by boiling water, and the addition of 20 per cent. alcohol to the cold infusion, to precipitate resinous principles as in the formula for the officinal syrup; this process is more simple than the first mentioned, and is nearly equally effective. Senna thus treated is a mild purgative and desirable as an ingredient in Species Laxantes, P. Ger.

Squill.—Scilla, U. S.—Bulb of Urginea Scilla, Steinheil. Nat. Ord., Liliaceæ. Constituents: scillipicrin, scillitoxin, scillin and mucilage. Off. Preparations: Acetum Scillæ; Extractum Scillæ Fluidum; Syrupus Scillæ compositus; Tinctura Scillæ.

Pharm. Uses: In the powdered form; obtained by drying the squill until crisp, and adding about ten per cent. of milk sugar during the process of powdering to preserve the squills in a pulverulent condition.

Taraxacum.—Taraxacum, U. S.—Dandelion. Root of Taraxacum Dens-lionis, Desfontaines. Nat. Ord., Compositæ. Constituents: inulin, taraxacin, resin, sugar, etc. Off. Preparations: Extractum Taraxaci; Extractum Taraxaci Fluidum.

Pharm. Uses: In various unofficinal preparations; the extract as excipient for Pills.

Thuja. (See Group 3).

Ustilago.—Ustilago, U. S.—Corn Smut. Ustilago Maydis, Levillè. Parasitic Fungus on Zea Mays, Linnè. Nat. Ord., Graminaceæ. Constituents: Fixed oil two and a half per cent., probably sclerotic acid, crystalline principle, etc.

Pharm. Uses: As Fluid Extract and Tincture, prepared similarly to those of Ergot.

Uva Ursi.—Uva Ursi, U. S.—Bearberry. Leaves of Arctostaphylos Uva Ursi, Sprengel. Nat. Ord., Ericaceæ. Constituents: tannin, arbutin, ericolin and ursone. Off. Preparation: Extractum Uva-Ursi Fluidum.

Pharm. Uses: In Decoction and Infusion, and associated with other diuretic medicines.

Viburnum.—Viburnum, U. S.—Black Haw. Bark of Viburnum prunifolium, Linnè. Nat. Ord., Caprifoliaceæ. Constituents: bitter principle (viburnin), bitter resin, valerianic acid, tannin. Off. Preparation: Extractum Viburni Fluidum.

Pharm. Uses: Similar to those of Valerian, which it closely resembles. Viburnum opulus or "Cramp Bark" is frequently preferred to V. prunifolium, because supposed to be more active.

UNOFFICINAL DRUGS—GROUP SIX.

Com. Name.	Bot. Name.	Part Used.	Constituents.
Agaric (white).	Boletus laricis.	White plant.	Laricin, bitter resin, agaric & other acids.
Ailanthus.	Ailanthus glandulosa.	Bark.	Ailanthic acid, tannin.
Apocynum (Dog's bane)	Apocynum Androsæmifolium.	R'zome.	Bitter principle, volatile oil.
Carduus Benedictus	Cnicus benedicus.	Herb.	Cnicin, tannin, etc.
Chamælirium (False Unicorn).	Chamælirium luteum.	R'zome.	Chamælirin.
Corn Silk.	Zea Mays.	Stigma.	Mayzenic acid, mucilage.
Convallaria (Lily of the Valley).	Convallaria majalis.	R'zome.	Convallarin, convallamarin.
Corydalis (Turkey Corn).	Dicantra Canadensis.	Tubers.	Corydalin, acrid resin, fumaric acid.
Coto.	(Source unknown).	Bark.	Cotoin, volatile oil piperonylic acid.
Epigæa (Gravel plant).	Epigæa repens.	Herb.	Arbutin, ericolin, ursone, tannin.
Helenium.	Helenium autumnale.	Herb.	Bitter Glucoside, resin, tannin.
Helleborus. (Black).	Helleborus niger.	R'zome.	Helleborin, helleborein, resin.
Hippocastanum(Horse chestnut).	Aesculus hippocastaneum.	Bark.	Aesculin, fraxin, tannin.
Imperatoria.	Imperatoria Ostruthina.	Root.	Imperatorin, volatile oil.
Kalmia.	Kalmia latifolia.	Leaves.	Arbutin, resin, tannin.
Lactuca.	Lactuca virosa.	Herb.	Lactucin, lactucic acid, lactucopicrin.
Larch.	Larix Americana.	Bark.	Larixinic acid, resin, tannin, volatile oil.
Liriodendron.	Liriodendron tulipifera.	Bark.	Liriodendrin, resin, tannin.
Piscidia.	Piscidia erythrina.	Bark.	Piscidin, resin, fixed oil.
Polygonatum.	Polygonatum biflorum and P. giganteum.	R'zome.	Convallarin, asparagin, etc.
Saponaria.	Saponaria officinalis.	Root.	Saponin.
Simaruba.	Simaruba officinalis.	Bark.	Quassin, resin, volatile oil.
Xanthium.	Xanthium spinosum and X. Strumarium.	Fruit.	Xanthostrumarin, resin.

Alkaloid—Preparation.

Drugs whose virtues depend partly or wholly on the presence of one or more alkaloids are alkaloidal.

Definition.—The alkaloids, or, as they are sometimes termed, vegetable alkalies, are peculiar organic bases containing nitrogen, in addition to carbon, hydrogen, and, with few exceptions, oxygen. They are allied to ammonia, and, when heated with alkalies, give off ammonia, by which they are distinguished from the glucosides and neutral principles. They form crystallizable salts with acids, and are, medicinally, the most powerful of all the organic principles.

Origin.—The alkaloids may be found in all parts of the plant, yet in the greater number they are contained in the seeds and fruits, and in trees they occur in the bark. They are usually combined in the plant with one or more vegetable acids, often peculiar to the plant, as meconic acid in opium, but frequently, also, with tannic acid or some derivative, of it, as kinic or kinovic acids in Cinchona.

Properties.—They are crystalline solids, with a few exceptions, viz.: Coniin, lobeline and nicotine which are liquid, and do not contain oxygen. The alkaloids are usually named after the *genus name* of the plant from which they are obtained, with the suffix of *ine* (Latin ina), thus distinguishing them from the neutral principles and glucosides, which terminate in *in* (Latin inum).

There are many exceptions, however, to this rule, as, for example: Morphine, named in honor of the god of sleep, *Morpheus;* when two or more alkaloids are obtained from the same plant, as in the *Cinchonas* and when the termination officinal in the U. S. P.'70, *ia*, is retained to distinguish a mixture of active principles from the true alkaloids, as in *aconitia*.

In solubility the alkaloids and their salts vary greatly; while a few, such as morphine, are readily soluble in water, by far the greater portion are insoluble, or only sparingly soluble in water; for example, quinine, strychnine, etc. These are freely soluble in alcohol, especially when hot; some also in ether, benzol, carbon disulphide, and ethereal oils, and others in amylic alcohol and chloroform. These liquids are variously used in their extraction, according to their solvent power.

GENERAL TESTS.

With chemical reagents the alkaloids behave similarly to ammonia, except in that they are all precipitated by tannic acid, which, forming an insoluble compound, is given as an antidote in cases of poisoning. Owing to their difference in composition, the reactions vary considerably, and are often characterized by the color produced, but the following are general tests:

1. *Nitric acid* imparts a reddish color.
2. *Phospho-molybdic acid* produces a yellow precipitate.
3. *Sodium phospho-tungstate* forms precipitates, insoluble in water, alcohol, ether, and in all the mineral acids, except phosphoric.
4. *Potassium-mercuric iodide*, a solution of mercuric chloride in potassium iodide, forms insoluble precipitates of a yellowish color in acidulated aqueous solutions (not alcoholic). It is used for the quantitative estimation of alkaloids. (See Nat. Disp.)

The preparation of alkaloids consists usually in extracting the drug with water acidulated with about two per cent. acid; with alkaloids difficultly soluble, the stronger mineral acid, *i. e.*, hydrochloric or sulphuric are used; with others more soluble the vegetable acids, acetic, citric and tartaric, are employed in the extraction, and with still others very soluble, such as morphine, the drug is exhausted with water alone, which dissolves it quite readily, as it exists in natural combination in the opium. From the watery solution the morphine is precipitated by an alkali, such as caustic lime or ammonia, which neutralizes the meconic acid, thus liberating the morphine, and may be obtained quite pure by dissolving it in boiling alcohol, filtering through animal charcoal, and allowing it to crystallize.

The Cinchona Alkaloids are best extracted with water, acidulated with hydrochloric acid, which, being much stronger than the acids with which the alkaloids are combined in the bark, replace them and forms soluble salts. The alkaloids are set free by a strong alkali; in this instance calcium hydrate (milk of lime) in excess, a portion neutralizing the acid, the remainder being insoluble precipitates, carrying the alkaloids with it. This precipitate is freed from the clear solution, which contains calcium chloride and some coloring matter, dried, powdered, and then extracted with hot alcohol repeatedly, which dissolves only the alkaloids, providing the mixture is free from water, until completely deprived of bitter taste, or exhausted. The alcoholic solution, usually somewhat colored, is filtered through animal charcoal, when the alkaloids may be obtained quite pure by slow evaporation of the alcohol. To produce salts, sulphates for example, the solution is rendered just perceptibly acid to litmus by the addition of dilute sulphuric acid, and allowed to crystallize. As the proportion of the various cinchona alkaloids varies greatly with the kind of bark operated upon, it is necessary to separate them; this is done sometimes at different stages of the crystallization, sometimes by solution in solvents, in which one of these is soluble, and others are insoluble.

With some drugs the water extracts so much inert matter, starch, etc., as to render the subsequent extraction of the alkaloids from the extract exceedingly difficult. In such cases, alcohol is used for extraction, but this also extracts other constituents usually present in alkaloidal drugs, such as resin and fat, and the extract, therefore, while more concentrated, still contains a considerable proportion of inert matter, which must be rejected before the alkaloid can be obtained pure. This is accomplished by mixing the extract with water acidulated with an appropriate acid, and thoroughly exhausting it by repeated washings with the latter. The alkaloidal base contained in the extract is formed into a salt by the acid, and is dissolved in the water, which contains acid in excess. The resinous and fatty constituents, however, are not soluble in water, and still less so in acidulated water, and these are therefore left behind. The alkaloids may now be precipitated by an alkali and dissolved in hot alcohol, the solution rendered as colorless as possible, either by filtration through animal charcoal, or purified by recrystallization.

Some of the alkaloids, owing to their complex constitution, are so delicate that they are split up into other substances when subjected to prolonged heat in evaporation, or treated with the stronger alkalies, as, for example, atropine, pilocarpine. These are obtained from the acidulated aqueous solution, first rendered slightly alkaline, so as to set the alkaloid free, by agitation with chloroform, which takes up the alkaloid, and, after settling to the bottom of the mixture, is drawn off, and leaves the pure alkaloid upon evaporation.

Alkaloids and Salts of the U. S. P.

FROM A TABLE BY AZOR THURSTON.

Alkaloids and Salts.	Formula.	Source.	Quantity. Alkaloid in Plant.	Solubilities in						Ordinary Adult Dose.
				Water.		Alcohol.		Ether.	Chloroform.	
				at 15° C 59° F.	Boiling.	at 15° C 59° F.	Boiling.			
Apomorphinæ Hydrochloras.	$C_{17}H_{17}NO_2HCl$	Morphine		6 8	Decomposed.	50	Decomposed.	Almost Insoluble.	Almost Insoluble.	gr. 1-10
Atropina	$C_{17}H_{22}NO_3$	Belladonna	About ½%	600		3.5	Very	60	3	1-60 gr.
Atropinæ Sulphas	$(C_{17}H_{23}NO_3)_2H_2SO_4$	Atropine		0.4	Very	6 5	Very	Insoluble.	Insoluble.	"
Caffeina	$C_8H_{10}N_4O.H_2O$	Tea, Coffee and Guarana.	About 1%	75	9.5	35	Very	Slightly.	6	1 to 3 gr.
Cinchonidinæ Sulphas	$(C_{20}H_{24}N_2O)_2H_2SO_4.3H_2O$	Cinchona		100	4	71	12	Very sparingly.	1000	1 to 20 gr.
Cinchonina	$C_{20}H_{24}N_2O$	Cinchona		Almost insoluble.	Almost insoluble.	110	28	371	350	"
Cinchoninæ Sulphas	$(C_{20}H_{24}N_2O)_2H_2SO_4.2H_2O$	Cinchona		70	14	6	1.5	Insoluble.	60	"
Codeina	$C_{18}H_{21}NO_3.H_2O$	Opium	1-5 to ½%	80	17	Very	Very	6	Very	¼ to 1 gr.
Hyoscyaminæ Sulphas	$(C_{17}H_{23}NO_3)_2H_2SO_4$	Hyoscyamus.	5-100%	Very		Very				1-60 to 1-20 gr.
Morphina	$C_{17}H_{19}NO_3.H_2O$	Opium	About 1 3% or limit 9%	Very slightly	500	100	36	Almost Insoluble.	Very Slightly.	¼ gr.
Morphinæ Acetas.	$C_{17}H_{19}NO_3HC_2H_3O_2.3H_2O$	Morphine	"	12	1.5	68	14	Insoluble.	60	"
Morphinæ Hydrochloras.	$C_{17}H_{19}NO_3HCl.3H_2O$	Directly from Opium	"	24	0.5	63	31	Insoluble		"
Morphinæ Sulphas	$(C_{17}H_{19}NO_3)_2H_2SO_4.5H_2O$		"	24	0.75	702	144	Insoluble		"
Physostigminæ Salicylas	$C_{15}H_{21}N_3O_2C_7H_6O_3$	Physostigma.	"	130	30	12	Very			1-80 gr.
Pilocarpinæ Hydrochloras.	$C_{11}H_{16}N_2O_2HCl$	Pilocarpus	¼ to ½%	Very		Very		Almost Insoluble.	Almost Insoluble.	Hypod. 1-6 gr.
Quinidinæ Sulphas	$(C_{20}H_{24}N_2O_2)_2H_2SO_4.2H_2O$	Cinchona		100	7	8	Very	Almost Insoluble	20	1 to 3 gr.
Quinina	$C_{20}H_{24}N_2O_2.3H_2O$	Cinchona	4 to 6% or limit 2%	1600	700	6	2	25	5	1 to 10 gr.
Quininæ Bisulphas	$C_{20}H_{24}N_2O_2H_2SO_4.7H_2O$	Quinine Sulphate.	"	10	Very	32	Very			"
Quininæ Hydrobromas.	$C_{20}H_{24}N_2O_2HBr.2H_2O$	Quinine Sulphate.	"	16	1	3	1	6	12	1 to 10 gr
Quininæ Hydrochloras.	$C_{20}H_{24}N_2O_2HCl.2H_2O$	"	"	34	1	3	Very		1	"
Quininæ Sulphas	$(C_{20}H_{24}N_2O_2)_2H_2SO_4.7H_2O$	Cinchona	"	740	30	65	3	Very slightly.	1000	"
Quininæ Valerianas.	$C_{20}H_{24}N_2O_2C_5H_{10}O_2.H_2O$	Quinine Sulphate.	"	100	40	5	1	Slightly.		1 to 5 gr.
Strychnina	$C_{21}H_{22}N_2O_2$	Nux Vomica or Ignatia.	¼ to ½%	6700	2500	110	12	Almost Insoluble.	6	1-60 to 1-20 gr.
Strychninæ Sulphas	$(C_{21}H_{22}N_2O_2)_2H_2SO_4.7H_2O$	Strychnine		10	2	60	2	Insoluble.		"
Veratrina	$[C_{32}H_{52}N_2O_8]$	Seeds of Asa græa Officinalis.	½%	Very slightly	Very slightly	3	Very	6	2	1-40 to 1-12 gr.

CHARACTERISTIC REACTIONS OF THE MOST IMPORTANT ALKALOIDS.

Apomorphine.—Sodium bicarbonate precipitates white amorphous alkaloid from solution, turning green on exposure to air and forming bluish green solution with alcohol, purple with ether, and violet or blue with chloroform.

Atropine.—Aqueous solution not precipitated with platinic chloride. Heated with sulphuric acid in potassium bichromate solution, gradually turns green, and develops orange flower odor.

Caffeine.—Evaporated with chlorine water leaves yellow mass, turning purple upon addition of ammonia. Potassiomercuric iodide gives no precipitate.

Cinchonidine.—Ammonia causes white precipitate, redissolving only in large excess. Should show but slight blue fluorescence with sulphuric acid.

Cinchonine.—Only slight fluorescence with sulphuric acid. Soluble in 371 parts ether.

Codeine.—Dissolves in sulphuric acid containing 1 p. c. sodium molybdate to a dirty green solution changing through blue to yellow. Sulphuric acid solution heated with trace of Fe_2Cl_6 turns deep blue.

Hyoscyamine.—Yield with gold chloride a precipitate which recrystallizes from boiling water, acidulated with HCl in brillant yellow scales—differing from atropine.

Morphine.—Acidulated solution not precipitated by tannic acid. Turns red and finally yellow with nitric acid, with ferric chloride blue, in excess green; decomposes iodic acid in solution.

Physostigmine Salicylate.—Solutions exposed to light for a short time turn reddish. Test also for salicylic acid.

Pilocarpine Hydrochlorate.—Ammonia produces no precipitate in slightly acidulated solution. With nitric acid (1.4 sp. gr.) faint greenish violet tint.

Quinidine.—Blue fluorescence with sulphuric acid Treated with chlorine water and slight excess of ammonia yields emerald green color.

Quinine.—As above distinguished by difference in solubility. See also Kerner's test U. S. P.

Strychnine.—A drop of sulphuric acid solution traced with a crystal of potassium bichromate is followed by deep blue, changing through violet and red to flesh color

Veratrine.—With sulphuric acid assumes yellow color changing through intense scarlet to violet red. Dissolves in HCl with blood red color.

Cinchona.—Opium.—Nux Vomica.

THE CINCHONA BARKS.

The Cinchona Barks are obtained from many different species of the genus Cinchona, and vary greatly in the proportion of alkaloids they contain, hence also in medicinal value.

The Pharmacopœia recognizes, by the term Cinchona, any bark, obtained from any species, containing not less than three per cent. of alkaloids. They are divided into three kinds, according to their color and to the relative proportion of the four principal alkaloids they contain, viz. :

Yellow Cinchona.—Cinchona Flava, U. S.—Calisaya Bark. Bark of trunk of Cinchona Calisaya, Weddell. Nat. Ord., Rubiaceæ, containing at least two per cent. of quinine. Constituents: kinic, kinovic, and cincho tannic acids ; quinine, quinidine, cinchonine, cinchonidine, and quinamine. Off. Preparations: Extractum Cinchonæ ; Extractum Cinchonæ Fluidum ; Infusum Cinchonæ ; Tinctura Cinchonæ.

This Cinchona, usually termed "Calisaya," contains the quinine in rather more than one-half the quantity of the total amount of alkaloids, the proportion of cinchonidine, and especially cinchonine, being quite small. The U. S. P. directs that this bark should contain at least two per cent. of quinine ; but good specimens contain nearly four per cent. of it, and about two per cent. of the less important alkaloids. Calisaya is also the most desirable kind of the Cinchonas pharmaceutically, because it contains less of the constituents, more or less inert and insoluble, such as cinchonic red, etc., and the liquid preparations are therefore less liable to precipitate than those made from other kinds of bark.

Red Cinchona.—Cinchona Rubra, U. S.—Bark of trunk of Cinchona succirubra, Pavon. Nat. Ord., Rubiaceæ, containing at least two per cent. of quinine. Constituents: (Same as C. Calisaya). Off. Preparation: Tinctura Cinchonæ composita.

The P. Br. directs the bark of the stem and branches of the species of Cinchona cultivated in the East Indies, and from which supplies are now chiefly derived. This bark occurs in the form of "quills," and is much thinner than the flat pieces formerly occurring in commerce.

This Cinchona, also known as Red Peruvian Bark or simply "Red Bark," contains usually somewhat less quinine than the Calisaya, and a much larger proportion of the other constituents, especially cinchonic red. It is nevertheless a more valuable tonic than the yellow kind, and for this reason is directed to be used in the compound tincture of cinchona. Its liquid preparations are exceedingly prone to precipitate, which is to a great extent avoided by the addition of glycerin to the menstrua, which serves to keep the cinchonic red in solution.

Pale Cinchona.—Cinchona Pallida, U. S., '70.—Pale Bark. Bark of Cinchona officinalis, Hooker, C. Condaminea, Humboldt & Bonpland. Nat. Ord., Rubiaceæ. Constituents same as the other kinds, but in much lesser proportion. It is not officinal.

Pale Bark also known as Loxa or Crown bark, is the least valuable of the three kinds. It is largely used, however, in "Tonics," and where the specific effects of the alkaloids are not desired.

Spurious barks are sometimes in the market and offered as Cinchonas, and especially as "Pale bark." They are distinguished by their different structure, also by the following: Grahes Test.—Ten grains of bark are heated (dry) in a test tube ; if genuine Cinchona, characteristic red vapors are evolved, which condenses into an oily carmine-red liquid.

Opium.—Opium, U. S.—Concrete milky exudation from capsules of Papaver somniferum, Linnè. Nat. Ord., Papaveraceæ. Constituents: morphine, codeine, thebaine, narcotine, narceine, pseudomorphine, papaverine, and many other alkaloids ; also meconic acid and meconin. Off. Preparations: Extractum Opii ; Opium Denarcotizatum ; Tinctura Opii Camphorata ; Tinctura Opii ; Acetum Opii ; Vinum Opii ; Tinctura Opii Deodorata ; Tinctura Ipecacuanhæ et Opii ; Pilulæ Opii ; Opii Pulvis ; Emplastrum Opii ; Pulvis Ipecacuanhæ et Opii ; Trochisci Glycyrrhizæ et Opii.

Opium contains about ten per cent. of moisture, in exceptional instances twenty or even thirty per cent., and from nine to fourteen per cent. of morphine. Preparations of opium should not be prepared from the crude drug, but from powdered opium, which should contain not less than twelve nor more than sixteen per cent. of morphine. The following forms are officinal :

Powdered Opium.—Opii Pulvis, U. S.—Prepared by drying the crude drug, first separated into smaller pieces, at a temperature not exceeding 185° F., until it ceases to lose weight, and then reduced to a moderately fine (50) powder. It is then assayed for its morphine strength (see Opium Assay, U. S. P.), and, if necessary, mixed with other specimens of powdered opium, to bring the strength within the limits prescribed by the Pharmacopœia.

Denarcotized Opium.—Opium Denarcotizatum, U. S. Prepared from powdered opium by macerating it successively with stronger ether, which removes the principles to which opium is supposed to owe its disturbing qualities. After being thus treated, the opium is carefully dried, and sugar of milk added in such proportion that the powder will contain fourteen per cent. of morphine. This is essentially the process employed in the preparation of deodorized tincture of opium. Petroleum benzin may be substituted for ether, owing to its economy ; although it does not extract the narcotine, it removes the principles which are supposed to be objectionable quite as completely as the more high-priced solvent.

For adulterations and means for their detection, see the U. S. or Nat. Disp. Opium or its preparations may be recognized by the deep red coloration produced by one of its constituents, meconic acid, with ferric salts, and differs from that produced with acetic acid by not disappearing on the addition of dilute hydrochloric acid.

In the preparation of the Tinctures and Extract, the opium is officinally directed to be exhausted with water alone, alcohol being added in the case of the tinctures simply to preserve the solution. The designation "aqueous," so much used commercially, should be abolished, for the reason that, since all the preparations are *aqueous*, any attempt at distinction simply tends to confusion.

Nux Vomica.—Nux Vomica, U. S.—Seed of Strychnos Nux vomica, Linnè. Nat. Ord., Loganiaceæ. Constituents ; Strychnine one-fourth to one-half per cent., brucine, loganine, igasuric acid and fixed oil. Off. Preparations: Abstractum Nucis Vomicæ ; Extractum Nucis Vomicæ ; Extractum Nucis Vomicæ Fluidum ; Tinctura Nucis Vomicæ.

Pharm. Uses : Chiefly for the preparation of Strychnine, one of the most powerful poisons, used extensively by trappers for killing fur-bearing animals ; also in the powdered form. Nux vomica is reduced to a powder only with great difficulty, owing to its flexible or horny character, and to the fact that it contains about five per cent. of fixed oil. By subjecting the seeds to the action of live-steam, however, and subsequently drying them, the integuments become brittle, and they are then easily powdered

Alkaloidal Drugs—(Continued).

Aconite Root.—Aconitum, U. S.—The tuberous Root of Aconitum Napellus, Linnè. Nat. Ord., Ranunculaceæ. Constituents: aconitine, napelline, fixed oil, etc. Off. Preparations: Abstractum Aconiti; Extractum Aconiti; Extractum Aconiti Fluidum; Tinctura Aconiti.

Aconite Leaves, formerly officinal, was discarded in the U. S. P., '80, which directs all preparations to be made from the root. Aconite *root* contains the active principles in greater proportion than the *leaf*, and preparations from the former, the only kind officially recognized, are therefore *stronger* than the preparations of the U. S. P., '70, made from the leaf, besides representing a larger quantity of drug. (Compare the Tinctures of the root and leaf, respectively). Great care must be exercised that the tincture or extract of the root be not dispensed (although those only are officinal) when the preparations of the leaf may be desired, but not specified.

Pharm. Uses: In preparing Aconitia, a mixture of the active principles, and a Liniment, both formerly officinal.

Belladonna Root.—Belladonnæ Radix, U. S.—Root of Atropa Belladonna, Linnè. Nat. Ord., Solanaceæ. Constituents: atropine about 0.4 per cent., belladonine, hyoscyamine, etc. Off. Preparations: Abstractum Belladonnæ; Emplastrum Belladonnæ; Extractum Belladonnæ Fluidum.

Pharm. Uses: In the preparation of Atropine and in the form of powder; the extract largely in Belladonna Plaster. Old and woody roots should be rejected, as their yield of alkaloids is much less than in young, plump and light colored specimens of the drug.

Belladonna Leaves.—Belladonnæ Folia, U. S.—Leaves of Atropa Belladonna, Linnè. Nat. Ord., Solanaceæ. Constituents: atropine from 0.1 to 0.5 per cent., belladonine, hyoscyamine, mucilage, etc. Off. Preparations: Extractum Belladonnæ Alcoholicum; Tinctura Belladonnæ.

Pharm. Uses: Similar to the root, to which, however, the leaves are regarded as being inferior, and more variable in strength.

Calumba. (See Group 6).

Chelidonium.—Chelidonium, U. S.—Celandine. Herb of Chelidonium majus, Linnè. Nat. Ord., Papaveraceæ. Constituents: chelidonine, sanguinarine, chelidoxanthine, chelidonic acid.

Pharm. Uses: As Fluid Extract, Tincture and Extract P. Ger., prepared from the juice expressed from the fresh leaves.

Colchicum Root.—Colchici Radix, U. S.—Tuber of Colchicum autumnale, Linnè. Nat. Ord., Melanthaceæ. Constituents: colchicine, starch, etc. Off. Preparations: Extractum Colchici Aceticum; Extractum Colchici Radicis Fluidum; Vinum Colchici Radicis.

Pharm. Uses: In the form of powder and in the preparation of an unofficinal Vinegar and Oxymel.

Colchicum Seed.—Colchici Semen, U. S.—Seed of Colchicum autumnale, Linnè. Nat. Ord., Melanthaceæ. Constituents: colchicine, colchiceine, fixed oil. Off. Preparations: Extractum Colchici Seminis Fluidum; Tinctura Colchici Seminis; Vinum Colchici Seminis.

Colchicum Seed contains a large proportion of fixed oil; its uses are similar to those of the root.

Conium.—Conium, U. S.—Poison Hemlock. Fruit of Conium maculatum, Linnè. Nat. Ord., Umbelliferæ. Constituents: coniine, conhydrine, fixed oil, volatile oil. Off. Preparations: Abstractum Conii; Extractum Conii Alcoholicum; Extractum Conii Fluidum; Tinctura Conii.

The alkaloid Coniine is very volatile, and care must be taken that preparations of conium be not subjected to a high temperature. The leaves, formerly officinal, have been discarded, owing to their being often inert.

Erythroxylon.—Erythroxylon, U. S.—Coca. Leaves of Erythroxylon Coca, Lamarck. Nat. Ord., Erythroxylaceæ. Constituents: cocaine and hygrine. Off. Preparation: Extractum Erythroxyli Fluid.

Pharm. Uses: In the preparation of the alkaloid Cocaine and its salts, chiefly the hydrochlorate, largely used as anæsthetics; also in the form of elixir, extract, wine and infusion.

Gelsemium.—Gelsemium, U. S.—Yellow Jasmine. Rhizome and rootlets of Gelsemium sempervirens, Aiton. Nat. Ord., Loganiaceæ. Constituents: volatile oil, gelsemine, gelseminic acid and resin. Off. Preparations: Extractum Gelsemii Fluidum; Tinctura Gelsemii.

Pharm. Uses: "Gelsemin," a resinoid and an Extract (solid) which represents ten times its weight of the drug.

Guarana.—Guarana, U. S.—Paste prepared from crushed seeds of Paullinia Sorbilis, Martius. Nat. Ord., Sapindaceæ. Constituents: caffeine four per cent., tannin, saponin and resin. Off. Preparation: Extractum Guaranæ Fluidum.

Pharm. Uses: In various Elixirs, simple and compound. In the powdered form and an Extract, one grain of which represents about four grains of the drug.

Hydrastis.—Hydrastis, U. S.—Golden Seal. Rhizome and rootlets of Hydrastis Canadensis, Linnè. Nat. Ord., Ranunculaceæ. Constituent: berberine, hydrastine. Off. Preparations: Extractum Hydrastis Fluidum; Tinctura Hydrastis.

Pharm. Uses: "Hydrastin," a resinoid; being a mixture of the active principle chiefly of berberine (hydrochlor). This term is a misnomer, because of the existence of a second alkaloid in this drug to which the term hydrastine has been applied. Also a Glycerite or so called "aqueous fluid extract." (See National Formulary).

Hops.—Humulus, U. S.—Strobiles of Humulus Lupulus, Linnè. Nat. Ord., Urticaceæ. Constituents: volatile oil, tannin four per cent., resin, lupuline. Off. Preparation: Tinctura Humuli.

Pharm. Uses: As Poultice or Plaster, infusion; and in the brewing of beer; also an unofficinal Extract and Fluid Extract.

Hyoscyamus.—Hyoscyamus, U. S.—Henbane. Leaves of Hyoscyamus niger, Linnè, Nat. Ord., Solanaceæ. (Should be collected from plants of second year's growth). Constituents: hyoscyamine, hyoscine and hyoscipicrin. Off. Preparations: Abstractum Hyoscyami; Extractum Hyoscyami Alcoholicum; Extractum Hyoscyami Fluidum; Tinctura Hyoscyami.

Pharm. Uses: In the powdered form, but chiefly in the form of Extract and Abstract, which is about one-third the strength of the extract.

Alkaloidal Drugs—(Continued).

Ignatia.—Ignatia, U. S.—St. Ignatius' Bean. Seed of Strychnos Ignatia, Bergius. Nat. Ord., Loganiaceæ. Constituents: strychnine, brucine. Officinal Preparations: Abstractum Ignatiæ; Tinctura Ignatiæ.

Pharm. Uses: Similar to Nux Vomica.

Ipecac.—Ipecacuanha, U. S.—Root of Cephaelis Ipecacuanha, A. Richard. Nat. Ord., Rubiaceæ. Constituents: emetine, ipecacuanhic acid, resin, etc. Off. Preparations: Extractum Ipecacuanhæ Fluidum; Pulvis Ipecacuanhæ et Opii; Trochisci Ipecacuanhæ; Trochisci Morphinæ et Ipecacuanhæ.

Pharm. Uses: In the form of powder (as a prompt emetic in doses of ten grains). The Syrup, Tincture of Ipecac and Opium, and Wine of Ipecac (U. S.) are all prepared from the fluid extract.

Lobelia.—Lobelia, U. S.—Leaves and tops of Lobelia inflata, Linnè. Collected after flowering, but before seeds are entirely ripe. Nat. Ord., Lobeliaceæ. Constituents: lobeline, lobelaerin, lobelic acid and resin. Off. Preparations: Acetum Lobeliæ; Extractum Lobeliæ Fluidum; Tinctura Lobeliæ.

Pharm. Uses: As Decoction and Infusion; sometimes in the form of powder; also in a number of preparations of the Eclectic school.

Menispermum.—Menispermum, U. S.—Moonseed. Rhizome and rootlets of Menispermum Canadense, Linnè. Nat. Ord., Menispermaceæ. Constituents: berberine, menispine, resin.

Pharm. Uses: Infusion, Unofficinal Fluid Extract and in several preparations of the Am. Dispensatory.

Pareira.—Pareira, U. S.—Pareira Brava. Root of Chondodendron tomentosum, Ruiz and Pavon. Nat. Ord., Menispermaceæ. Constituents: pelosine, resin. Off. Preparation: Extractum Pareiræ Fluidum.

Pharm. Uses: In Decoction and Infusion.

Pepper. (See Group 2).

Physostigma.—Physostigma, U. S.—Calabar-Bean. Seed of Physostigma venenosum, Balfour. Nat. Ord., Leguminosæ. Constituents: physostigmine, calabarine, and physosterin. Off. Preparations: Extractum Physostigmatis; Tinctura Physostigmatis.

Pharm. Uses: In the preparation of the alkaloid and its officinal salt, Physostigmine Salicylate.

Pilocarpus.—Pilocarpus, U. S.—Jaborandi. Leaflets of Pilocarpus pennatifolius, Lemaire. Nat. Ord., Rutaceæ. Constituents: pilocarpine, volatile oil. Off. Preparation: Extractum Pilocarpi Fluidum.

Pharm. Uses: Infusion and in the preparation of the alkaloid Pilocarpine, and its various salts, hydrochlorate, nitrate, etc.

Pomegranate.—Granatum, U. S.—Root bark of Punica Granatum, Linnè. Nat. Ord., Granataceæ. Constituents: pelletierine, punicine, tannin, etc.

Pharm. Uses: In Decoction, and in the preparation of pelletierine tannate, both used as remedies for Tænia.

Sanguinaria.—Sanguinaria, U. S.—Bloodroot. Rhizome of Sanguinaria Canadensis, Linnè. Nat. Ord., Papaveraceæ. Constituents: sanguinarine one per cent., resins. Off. Preparations: Aectum Sanguinariæ; Extractum Sanguinariæ Fluidum; Tinctura Sanguinariæ.

Pharm. Uses: In the form of powder, as a sternutatory and emetic; also in the preparation of an Extract, and as Decoction.

Scoparius.—Scoparius, U. S.—Broom. Tops of Sarothamnus Scoparius, Koch. Nat. Ord., Leguminosæ. Constituents: scoparin, sparteine, tannin, volatile oil.

Pharm. Uses: An unofficinal Fluid Extract and Decoction.

Spigelia.—Spigelia, U. S.—Pink Root. Rhizome and rootlets of Spigelia Marilandica, Linnè. Nat. Ord., Loganiaecæ. Constituents: volatile oil, bitter alkaloidal principle, resin. Off. Preparation: Extractum Spigeliæ Fluidum.

Pharm. Uses: Infusion and Decoction, usually associated with purgatives, such as Senna. The Comp. Fluid Extract Spigelia and Senna was formerly officinal.

Staphisagria.—Staphisagria, U. S.—Stavesacre. Seed of Delphinium Staphisagria, Linnè. Nat. Ord., Ranuneulaceæ. Constituents: delphinine, delphinoidine, delphisine and fixed oil.

Pharm. Uses: Chiefly as an insecticide, the whole seeds being used, also in the form of Tincture.

Stramonium Leaves.—Stramonii Folia, U. S.—Leaves of Datura Stramonium, Linnè. Nat. Ord., Solanaceæ. Constituents: atropine and hyoscyamine, the mixture of the two formerly called daturine.

Stramonium leaves has been superseded by the seeds, these being more active, in the officinal preparations.

Stramonium Seeds.—Stramonii Semen, U. S.—Seeds of Datura Stramonium, Linnè. Nat. Ord., Solanaceæ. Constituents: atropine, hyoseyamine, fixed oil twenty-five per cent. Off. Preparations: Extractum Stramonii; Extraetum Stramonii Fluidum; Tinctura Stramonii.

Liquid preparations of Stramonium seed, owing to the considerable quantity of fixed oil they contain, are very prone to precipitation. An Ointment is prepared from the extract.

Tobacco.—Tabacum, U. S.—Dried leaves Nicotiana Tabaeum, Linné. Nat. Ord., Solanaceæ. Constituents: nieotine two to ten per cent., nieotianin, resin, extractive matter.

Pharm. Uses: In the form of powder, "Snuff." An Ointment is prepared from an aqueous extract of the leaves; Oil of Tobacco by dry distillation.

Veratrum Viride.—Veratrum Viride, U. S.—(American or Green Hellebore). Rhizome and rootlets of Veratrum viride, Aiton. Nat. Ord., Melanthaceæ. Constituents: jervine, pseudo-jervine, rubijervine, veratroidine and resin. Off. Preparations: Extraetum Veratri Viridis Fluidum; Tinctura Veratri Viridis.

The use of preparations made from drugs in the fresh (green) condition, has with some physicians become exceedingly popular. No drugs, whose virtues depend on volatile principles or constituents whose medical activity may be modified or destroyed by the heat required in desiccation, are included in this group. Alkaloidal drugs, dried with proper care, yield more definite and reliable preparations than those made from "green drugs," and should therefore be given the preference.

Alkaloidal Drugs—(Concluded).—Animal Drugs.

UNOFFICINAL ALKALOIDAL DRUGS—GROUP SEVEN.

Com. Name.	Bot. Name.	Part Used.	Constituents.
Achillea.	Achillæa millefolium.	Herb.	Achilleine, resin, volatile oil, tannin.
Alstonia.	Alstoniaeonstrieta	Bark.	Ditaine, ditamine, resin.
Angustura.	Galipea eusparia.	Bark.	Angusturine, resins, vol. oil.
Ash (white)	Fraxinus Americana.	Bark.	Alkaloid, volatile oil.
Baptisia.	Baptisia tinctoria.	Root.	Baptisine, resin, etc.
Barberry.	Berberis vulgaris. Berberis aquifolium.	Root or Root b'k R'zome.	Berberine, vinetine, etc.
Boldus.	Boldoa fragrans.	Leaves.	Boldine, resin, volatile oil.
Cevadilla.	Veratrum Sabadilla.	Seeds.	Veratrine, cevadine, cevadillin.
Cicuta.	Cicuta maculata.	Herb.	Cicutine.
Coffee.	Caffæa Arabica.	Seeds.	Caffeine, vol. oil, tannin.
Cuprea B'rk	Remijia pedanculata. Remijia Purdieana		Quinine and other Chichona alkaloids.
Delphinium	Delphinum Consolida.	Seeds.	Delphinine, fix'd oil, etc.
Gold Thread	Coptis trifoliata.	Herb.	Berberine, coptine, resin.
Jequiriti.	Abrus precatorius.	Seeds.	Alkaloid, abric acid, fixed oil.
Maté.	Ilex Paraguensis.	Leaves.	Caffeine, tannin, volatile oil.
Neetandra.	Neetandra Rodiæi.	Bark.	Beberine, sipirine, etc.
Poppy.	Papaver somniferum.	Fruits.	Opium alkaloids (see Opium).
Ptelea.	Ptelea trifoliata.	Root b'k	Berberine, volatile oil, etc.
Quebracho.	Quebracho blaneo.	Bark.	Aspidospermine, quebrachine, tannin.
Sarraeenia.	Sarraeenia purpurea.	Herb & Root.	Sarracenine, acrylic, and sarraecnic acids.
Theobroma.	Theobroma eacao.	Seeds.	Caffeine, theobromine, fixed oils.
Veratrum (white Hellebore).	Veratrum album.	R'zome.	Jervine, pseudojervine, rubijervine, veratralbine, etc.
Xanthorrhiza.	Xanthorrhiza apiifolia.	Root.	Berberine.

Artificial Alkaloids are produced from natural alkaloids:

(1) By decomposition with alkalies, as in coniine, ethylamine, propylamine, methylamine and pipiridine.

(2) From other alkaloids and coal-tar, as apomorphine, chinoline, pyridine, and a series of coal-tar derivatives, including the anilines and the artificial substitutes for the cinchona alkaloids.

Animal Alkaloids are found distributed in different parts of animal bodies, sometimes in the healthy flesh, as *creatinine;* in the blood and urine, as *urea*, and as products of decomposition in cadavers possessing poisonous properties, termed *ptomaines.*

UNCLASSIFIED DRUGS—GROUP EIGHT.

This is a miscellaneous group, and includes all those vegetable drugs whose constituents are not known, and those also whose constituents are of such a character that they cannot properly be classed under any of the other groups.

Drugs of *animal origin*, not previously treated of, are also placed in this group.

Cantharides.—Cantharis, U. S. Whole animal of Cantharis vesicatoria, De Geer. Nat. Ord., Coleoptera of the class Insecta. Constituents: cantharidin. Off. Preparations: Ceratum Cantharidis; Ceratum Extracti Cantharidis; Charta Cantharidis; Collodium cum Cantharide; Linimentum Cantharidis; Tinctura Cantharidis.

Pharm. Uses: Chiefly in the form of Cerate for spreading "Blisters."

Charcoal.—Carbo Ligni, U. S. Prepared from soft wood by burning it with a limited supply of air. Constituents: carbon and various earthy matters.

Pharm. Uses: As an ingredient in Dentifrices and in compound powders and Troches for Indigestion.

Animal Charcoal.—Carbo Animalis, U. S. Prepared from the bones of vertebrate animals by burning them with a limited supply of air. Constituents: carbon, phosphate and carbonate of lime, etc. Off. Preparation: Carbo Animalis Purificatus.

Pharm. Uses: For preparing purified charcoal by digesting the crude boneblack with diluted hydrochloric acid, and carefully washing the residue. For decolorizing solutions of vegetable substances, as in the preparation of alkaloids and sugar; also for absorbing foreign matter, *i. e.*, fusel oil from alcohol, and for purifying water, etc.

Cochineal.—Coccus, U. S. Dried female of Coccus cacti, Linnè. Nat. Ord., Hemoptera of the class Insecta. Constituents: carminic acid. Off. Preparation: Tinctura Cardamomi Comp.

Pharm. Uses: In Comp. Tincture Cochineal for coloring Elixirs and for preparing Carmine, which is a compound of the coloring principle with alumina, etc.

Ox Gall.—Fel Bovis, U. S. Fresh gall of Bos Taurus, Linnè. Nat. Ord., Ruminantia of the class Mammalia. Constituents: bilirubin, cholesterin, glycocholic and taurocholic acids. Off. Preparations: Fel Bovis Inspissatum; Fel Bovis Purificatum.

Pharm. Uses: Exceedingly rare; sometimes in pills.

Isinglass.—Ichthyocolla, U. S. Swimming bladder of Acipenser Huso, Linnè, and other species of the same genus. Nat. Ord., Sturiones of the class Pisces. Constituents: gelatin. Off. Preparation: Emplastrum Ichthyocollæ.

Pharm. Uses: In the preparation of "court plaster" and as a clarifying agent in brewing, etc. Russian Isinglass is the most valuable and is the kind chiefly employed. American isinglass is prepared from the sounds of the Hake; it is inferior to the first-mentioned and much cheaper.

Animal and Unclassified Drugs.

Musk.—Moschus, U. S.—Dried secretion from preputial follieles of male of Moschus moschiferus Linne. Nat. Ord., Ruminantia of the class Mammalia. Constituents: cholesterin, fat, ammonia, albuminous and gelatinous substances, etc. Off. Preparation: Tinctura Moschi.

Pharm. Uses: In Flavoring and Perfumery.

Pepsin (Saccharated).—Pepsinum Saccharatum, U. S.—Pepsin 50°. The digestive prineiple of the gastric juice, obtained from the mucous membrane (inner lining) of the stomaeh of the hog, mixed with sugar of milk. Off. Preparation: Liquor Pepsini.

The U. S. P. directs that it should be of such *strength* that one grain dissolved in 500 grains of water, acidulated with 7.5 grains hydrochloric acid, mixed with fifty grains hard-boiled egg-albumen in thin shavings, should form a mixture, which on being kept at a temperature of 100° to 104° F., and frequently agitated, becomes a slightly opalescent solution in five or six hours.

This officinal pepsin is four times stronger than that formerly sold as saccharated, of which one grain dissolved 12 grains albumen; it should invariably be dispensed when pepsin is directed to be used. In testing pepsin care must be taken that the albumen is thoroughly disintegrated so that all portions of it be exposed to the peptic fluid. Also that the prescribed temperature be maintained. The addition of acid is necessary because pepsin is active only in acidulated solutions, as in the gastric juice in the stomach, while the other digestive principle, pancreatin, is active only in alkaline solutions —the bile.

The fermentative action of the pepsin converts albuminous matter into a soluble readily assimilable form termed peptone, which is the ultimate product of all albuminous substances before they can enter the system *as food.* Pure Pepsin, representing a digestive action of 500 to 1, or ten times the strength of the officinal when free from disagreeable odor, may be used for preparing the latter by simply mixing it with nine times its weight of milk sugar. (See National Formulary).

Pharm. Uses: In many Elixirs; wherein frequently the pepsin is sacrificed or precipitated, as in combination with bismuth or other substances requiring alkaline media for solution. Glycerin is a good solvent for pepsin and preserves it without the addition of acid; the glycerin may be used in preparing elixirs where the acid is objectionable. Pepsin is precipitated in liquids containing alcohol above thirty per cent., but in less proportion alcohol preserves it and the wine of Pepsin, prepared by maccrating the mucous membrane scraped from the stomachs in white wine, is an active preparation. Pepsin enters into several Compound Powders, associated with pancreatin and ptyalin. (For formulas for a Glycerite, Wine. Elixirs, and various other preparations of Pepsin, see National Formulary).

Pancreatin.—Panereatinum.—A peculiar ferment, the active principle of the pancreatic juice, secreted by the *pancreas*, a gland situated near the lower abdomen in carnivorous animals. Constituents: Several complex albuminous substances.

Pharm. Uses: Mixed with milk sugar in the powdered form (Saccharated); also in Elixirs, Wines, and Compound Powder of Pepsin. (See National Formulary).

Yolk of Egg.—Vitellus, U. S.—Yolk of Egg of Gallus Bankiva, var. domesticus, Temmniek. Nat. Ord., Gallinæ of the class Aves. Constituents: vitellin, fixed oil, inorganic salts, etc. Off. Preparation: Glyeeritum Vitelli.

Pharm. Uses: For preparing Emulsions, espccially with strongly alcoholic liquids, for example, spirit nitrous ether, in which acacia would precipitate.

UNOFFICINAL DRUGS—GROUP EIGHT.

Com. Name.	Scientific Name.	Part Used.	Constituents.
	Vegetable Drugs		
Cactus.	Cactus grandiflorus.	Herb.	Acrid juice (No analysis).
Clover Tops	Trifolium Pratense.	Flowering tops	(No analysis).
Fucus.	Fucus vesiculosus and other species of Fucus.	Whole plant.	Salts of Iodine, brominc, etc.
Galium.	Galium Aparine.	Herb.	Cumarine, tannin, etc.
Hydrangea.	Hydrangea arborescens.	Root.	(No analysis).
Mitchella.	Mitchella repens.	Herb.	(No analysis).
	Animal Drugs.		
Ambergris.	Ambra Grisea.		Ambriin, etc.
Blatta.	Blatta Orientalis.	Insect.	Antihydropin, fats, etc.
Castoreum.	Castor Fiber.	Glandular Secretion	Vol. oil, castorin, salicine, etc.
Civet.	Viverra Zibetha, or Viverra Civetta.	Glandular Secretion	Volatile oil, fat, resinous matter, salts, etc.
Bone.	Os.		Calcium phosphates, calcium carbonates, magnesium phosphates, animal matter, etc.
Coral.	Corallium rubrum and oculina Virginea.	Calcareous Skeleton.	Calcium carbonate, magnesium carbonate, animal matter.
Cuttle-bone.	Os Sepiæ.	Calcareous Skeleton.	Calcium carbonate, magnesium carbonate, animal matter, traces of phosphates.
Gelatin.	Gelatina.		(Glue consists of gelatin, chondrin, and various impurities).
Hyraceum.	Hyrax Capensis.	Excretion or Secretion.	Vol. oil, resin, fat, various acids and salts.
Milk.	Lac vaccinum.		Casein, lactoprotein, fixed oil, milk, sugar, various salts.
Pancreatin.	Pancreatinum.		Several complex ferments.
Ptyalin.	Ptyalin.		Similar to Diastase.
Sponge.	Spongia officinalis	Horny Skeleton or Ash.	Spongin, various salts, including iodides

Questions on Lecture VII.—Series 7.

1. What Classification is made of Organic Drugs?
2. What *bearing* has a knowledge of their Constituents upon the Practice of Pharmacy?
3. What qualities should characterize a *proper* Menstruum?
4. What are the active Constituents of Resinous Drugs?
5. What Constituents characterize the drugs of Group I?
6. Which of the Demulcent Drugs contain a considerable proportion of Fixed Oil?
7. In making Syrup of Althæa, why is the macerate of water drained *without* expression?
8. Althæa contains Asparagin; what common garden herb contains the same principle?
9. What drug furnishes Mannit in considerable proportion?
10. What are the constituents of the drugs of the Aromatic Group?
11. What are the two common commercial varieties of Ginger? Which is preferable for pharmaceutic uses?
12. Can Fluid Extracts be prepared from Aromatic Drugs such as Ginger that will mix *clear* with water?
13. In making Infusion Digitalis according to the U. S. P., what objection is there to combining the Digitalis with Cinnamon?
14. In making preparations of fresh Orange peel, why is the "white" of the rind rejected?
15. What class of *unofficinal* pharmaceutical preparations are made from many Resinous Drugs?
16. Which of the Resinous Drugs contains a principle also found in Rhubarb?
17. What Resinous drugs are used as tænifuges?
18. What is the *best* general menstruum for the Astringent Drugs, Group IV.?
19. What principle characterizes Drugs of this Group?
20. How would you prepare Tincture of Gossypium bark and why?
21. Mention the Substances *incompatible* with the preparations of Astringent Drugs.
22. How does Gallotannic Acid differ from other Tannins?
23. Why is Nutgall used in the preparation of Inks?

☞Make Definitions Brief and in Your Own Language.

IMPORTANT.

Students will please reply to the above questions on *letter-size* paper, *in ink*, writing only on *one* side of the paper, and forward promptly to the director, signed. In answering, it is *not* necessary to repeat the question itself but only the *number* of each question, which must be written in the margin. Write a copy of your answers and preserve it for future use.

☞ In order to insure prompt attention all the rules of the "Important Notice" must be complied with.

Director.

National Institute of Pharmacy.

LECTURES, SEMI-MONTHLY, BY MAIL.
C. S. HALLBERG, Ph. G., *Director.*

DEPARTMENT OF EXAMINATIONS.

CHICAGO, Oct, 1891.

C. F. Carpenter, East Hampton, Conn.

Upon Questions on Lecture VIII, Series 7, we transmit the following printed answers for further comparison and study:

1. Organic Acids, such as citric, malic, and tartaric. acids.
2. They allay thirst and possess mildly laxative properties.
3. Water.
4. (*a*) Drugs possessing a fermentative albuminous and a decomposable glucosidal or alkaloidal principle which react upon each other under certain conditions to produce new compounds. (*b*) Presence of water.
5. No.
6. To permit development of Hydrocyanic Acid.
7. They are known to be closely allied; further than this nothing definite can be stated.
8. (*a*) Aloin.
   (*b*) 10 to 16 per cent.
9. (*a*) Refer to page 80.
   (*b*) Neutral Principles.
10. (*a*) It is the sclerotium of Claviceps purpurea.
    (*b*) Fluid Extract, Extract, and Wine.
11. As a source of Chrysarobin and in Ointments.
12. Calumba, Hydrastis and Menispermum.
13. (*a*) Alcohol fails to extract the laxative principles.
    (*b*) Water, after the removal of the bitter principles by means of alcohol.
14. Refer to page 85.
15. ———.
16. Alkaloids, *ine* in English and *ina* in Latin; Glucosides, *in* in English and *inum* in Latin.
17. Refer to page 85.
18. Refer to page 85, Col. 2, par. 1.
19. Water.
20. 1.4 per cent.
21. Should contain at least 3 per cent. of alkaloids.
22. ½ grain.
23. (*a*) A ferment derived from the stomach.
    (*b*) Saccharated Pepsin.
24. Astringent, alcoholic, and alkaline.
25. By ascertaining how much albumen it will render soluble in a specified period of time.
26. Peptone is the ultimate product of the action of Pepsin upon albuminoids.
27. (*b*) A ferment derived from the pancreas.
    (*a*) In compound digestive powders, wines, elixirs, for emulsionizing fats and oils, for peptonizing meat and milk, etc.

Your rating on answers to Lecture 8 *is* 95 *per cent.*

The abbreviations "P.," "Col." and Par.," are used to indicate "page," "column," and "paragraph," respectively.

In rating the answers, your *general understanding of the subjects* and the *appearance of your paper*, are also taken into consideration.

☞ The above questions should be *carefully reviewed* upon receipt of corrections. If questions to any other Lectures remain unanswered, please send them in at once.

THE DIRECTOR.

Always continue to answer in the regular order without waiting for delayed observations. Corrections are always forwarded as promptly as possible.

☞ NOTICE.—Do not fail to write your name, full address and CLASS page 627, at the TOP of the first page of your answers.
In all correspondence the CLASS page must be stated in order to insure prompt attention.

The Inorganic Acids.

THE INORGANIC OR MINERAL ACIDS.

Acids, whether organic or inorganic, except in the case of the so-called *haloid* acids, like Hydro-chloric Acid, are built on the type of the water-molecule, and consist of an atom or a group of atoms united by Oxygen to Hydrogen. If we represent the water-molecule thus: H—O—H, an acid molecule would be represented thus: · X—O—H, X representing the negative atom or group of atoms.

Acids are characterized, when soluble, by possessing a sour taste, by the property of changing certain vegetable blues, like blue litmus, to red, and by the power they have of combining with bases to produce salts. [For a discussion of the difference between organic and inorganic acids, see Lecture V, page 45].

Some acids are *mono*-basic, that is, are built on the plan of one water-molecule, and have one replaceable hydrogen atom, as Nitric Acid, H—O—(NO_2); others are *di*-basic and have two replaceable hydrogen atoms as Sulphuric Acid $\begin{matrix}H—O\\H—O\end{matrix}\rangle(SO_2)$; and some other acids have a still higher basicity.

In the mineral or inorganic acids the number of hydrogen acids in the formula indicates the *basicity* of the acid, but this is not always true of the organic acids, since one or more hydrogen atoms may enter into the constitution of the complex negative radical. Mineral acids with but *one* hydrogen atom can form but *one* series of salts by combining with bases, but those that have two or more hydrogen atoms may form two or more series, according as all or only a part of the hydrogen atoms are replaced by the basic radical.

For example, Sulphuric Acid, H_2SO_4, may react upon soda and produce, under different circumstances, two different salts. In case both its Hydrogen atoms are replaced by Sodium, neutral Sulphate of Sodium. Na_2SO_4, will be produced, but if only one of the Hydrogen atoms is replaced by the Sodium, acid Sulphate of Sodium, $HNaSO_4$ will be produced. The latter salt still possesses acid properties.

The *haloid* acids differ from the other in molecular plan by having the negative radical directly united to hydrogen without the mediation of an oxygen atom, as Hydrochloric Acid, HCl, Hydrobromic Acid, HBr, and Hydriodic Acid, HI. These acids form a corresponding series of salts by uniting with bases. Common salt, NaCl, is an illustration.

Some of the acids are solid, some liquid, and some gaseous at ordinary temperatures. Only those inorganic acids of most importance in pharmacy will here be described. They will be described in alphabetical order as follows:

Arsenious, Boric, Carbonic, Chromic, Hydrobromic, Hydrochloric, Hydrocyanic, Nitric, Nitrohydrochloric, Phosphoric, Sulphuric, Sulphurous, and Hydrofluoric, not officinal.

Arsenious Acid.—Acidum Arseniosum, U. S.—Is not in the strict sense an acid at all, but arsenious oxide, or arsenious anhydride, As_2O_3. However, if this oxide be dissolved in water, true arsenious acid, H_3AsO_3, is formed; hence, in the presence of moisture, arsenious oxide always exhibits an acid reaction.

Description.—A heavy, white solid, existing either in the amorphous or crystalline condition, and the specific gravity varying according to its condition from 3.738 to 3.689. The amorphous modification has the higher specific gravity, and is transparent or semi-transparent, but on standing becomes opaque by the formation of minute octahedral crystals at the surface. This process goes on gradually from the surface toward the interior until the entire mass becomes crystalline. The appearance of the mass then resembles porcelain. On heating it carefully to a temperature of 200° C. it fuses without volatilization, and the cooled vapor deposits minute octahedral crystals.

Solubility.—Its solubility in water varies with its physical condition, sometimes requiring thirty parts and sometimes as high as eighty parts of the solvent. It is slowly but completely soluble in 15 parts of boiling water, and the solution on cooling deposits transparent, regular octahedral crystals. It is slightly soluble in alcohol, moderately soluble in glycerin, and freely soluble in hydrochloric acid and in solutions of the alkalies and their carbonates.

Tests.—When thrown upon ignited charcoal the oxide is reduced, and emits an alliaceous odor. Its aqueous solution affords a lemon-yellow precipitate with a solution of ammonio-nitrate of silver, and a grass-green precipitate with ammonio-sulphate of copper. If the aqueous solution be acidulated with hydrochloric acid, and a stream of sulphureted hydrogen be passed through it, a bright yellow precipitate of arsenious sulphide will be produced. This precipitate is distinguished from the similar sulphides of antimony and tin by its insolubility in hydrochloric acid and by its solubility in test solution of carbonate ammonium.

Arsenious acid is a powerful irritant poison, and as it is the commonest form in which arsenic occurs in commerce, the majority of the cases of arsenical poisoning are produced by it. The maximum safe dose for an adult is about $\frac{1}{13}$ of a grain. The best antidote is freshly precipitated ferric hydrate.

(For the preparation of the latter see the U. S. P.)

Off. Prep.:—Liquor Acidi Arseniosi, and Liquor Potassii Arsenitis.

Hydrofluoric Acid.—HF.—Acidum Hydrofluoricum. A haloid acid. Not officinal.

Source.—Best obtained by distilling powdered fluor-spar with sulphuric acid in a leaden retort, and condensing the vapors in water. Great care should be observed in the process not to breathe the vapors, as they are highly irritant and poisonous.

Properties:—Pure hydrofluoric acid is a colorless, mobile, fuming liquid, lighter than water, and highly volatile. It boils at 19.4° C., and is very soluble in water. The aqueous solution—generally called hydrofluoric acid—is usually preferred in the arts. A solution whose sp. gr. is 1.15 contains 35.37 per cent. of hydrofluoric acid. It is an extremely caustic liquid, and must be preserved in bottles made of gutta-percha or lead. Its principal use is for etching on glass.

Inorganic Acids—(Continued).

Boric Acid—Acidum Boricum, U. S.—A tribasic acid having the formula H_3BO_3.

Description and Properties.—Transparent, shining, six-sided plates, which are somewhat unctuous to the touch, permanent in the air, odorless, bitterish, feebly acid, changing blue litmus paper to red, and turmeric paper to brown, the brown color of the latter not being altered in the presence of free hydrochloric acid. At 19° C. it is soluble in 25.66 parts of water, and at 100° C. in 2.97 parts. It is soluble in 15 parts of alcohol at 15° C. and in five parts of boiling alcohol.

Sources.—The principal commercial source of boric acid is the steam jets or fumaroles that issue from the earth in some districts in Tuscany. The acid that issues in these jets collects in the waters of the lagoons or lakelets formed near the orifices whence the jets issue, and is obtained in the crystalline form by evaporation. Borax is produced by treating the concentrated solution with sodium carbonate. Borax occurs as a crystalline deposit in a lake in California, and is also prepared from various borates, found in Nevada and South America.

Pharm. Uses: Chiefly valuable for its anti-fermentative and anti-putrescent properties. It is sometimes administered internally, but more commonly as an external application, combined with an absorbent powder such as starch; or in solution or in the form of ointment prepared with petrolatum. Owing to the difficulty with which it is obtained in fine powder in the preparation of ointments, the acid should be first triturated with a portion of the fused fat in a hot mortar before the whole of the fat is incorporated. Boric acid may be obtained in the dry powdered form by triturating it with a few drops of ether or glycerin. A saturated solution of hot water gradually poured into a large quantity of cold water with constant stirring, yields the acid in a fine state of division.

Preparation.—Boro-glyceride prepared by heating 62 parts of boric acid with 92 parts of glycerin to 300° F., until aqueous vapors cease to rise.

Carbonic Acid.—Acidum Carbonicum.—This is a dibasic acid having the formula H_2CO_3. It is not stable at ordinary temperatures, decomposing into H_2O and CO_2, hence it is mainly known through its compounds, the carbonates.

When carbon dioxide is forced into water, as in charging soda fountains, the water acquires a pleasant acid taste, and a slight acid reaction, which is doubtless due to the formation of carbonic acid by the union of the carbon dioxide with water. Carbonic acid is a feeble acid, being readily displaced from its combinations by the mineral and many of the organic acids. As the displaced acid escapes it is immediately decomposed, and the escaping gas, CO_2, produces effervescence. Frequently the chemical affinity between the carbonic acid and the base is so feeble in the carbonates that a moderate heat suffices for their decomposition. Calcium carbonate affords a familiar illustration.

Uses: Although carbonic acid, save in the form of carbonated waters, has little use in pharmacy, many of the carbonates are of great importance. (These are treated under the metals with which it forms compounds).

Chromic Acid.—Acidum Chromicum, U. S.—As in the case of Arsenious acid, the above names are in the strict sense incorrect, as they are applied to the tri-oxide or anhydride, whose formula is CrO_3. The solution of this oxide in water, however, forms true Chromic acid, H_2CrO_4.

Source.—Chromic andydride is usually obtained by adding to one volume of cold, saturated solution of Potassium Bichromate one and one-half volumes of concentrated Sulphuric Acid. The anhydride crystallizes out on cooling in the form of delicate red needles.

Description and Properties.—Delicate crimson, needle-like crystals, or strongly lustrous, scarlet, rhombic prisms, strongly deliquescent in moist air, without odor, and intensely caustic when brought in contact with animal tissues. It is highly soluble in water, forming a deep orange-red solution. If strong alcohol be dropped on the crystals, chemical change takes place with incandescence, the anhydride being reduced to the green sesqui-oxide of chromium. The sp. gr. is 2.78, the crystals fuse at 193° C. to a deep red liquid, and if the temperature be raised to 250° C., decomposition occurs, and the anhydride is reduced to Cr_2O_3, with the evolution of oxygen.

Precautions in handling: By mixing chromic anhydride with alcohol, glycerin, or other readily oxidizable substances, rapid combustion, or even explosion, may be produced. Owing to its strong affinity for water it must be kept in tightly stoppered bottles.

Uses: In medicine, chiefly as caustic; in microscopy, for hardening tissues.

Hydrobromic Acid.—Acidum Hydrobromicum.—A haloid acid having the formula HBr.

Preparation.—It is made by causing Water to react on the Bromide of Phosphorus, as expressed in the following equation:

$$PBr + 4H_2O = 5HBr + H_3PO_4.$$

The hydrobromic acid is separated from the phosphoric acid by distillation.

Properties.—A colorless gas, with a strong, irritating smell, and an acid taste and reaction. It liquifies only at the low temperature of —73° C. and becomes a colorless solid at —87° C. It fumes on exposure to the air, as also does its aqueous solution. Like hydrochloric acid, it has a strong affinity for water, and dissolves in it in very large proportion. It is the aqueous solution which is generally used in the arts, and it is this to which the name, hydrobromic acid, is usually applied. The aqueous solution that contains 49.8 per cent. of the acid gas has a sp. gr. of 1.515.

Acidum Hydrobromicum Dilutum, U. S.—A transparent, colorless liquid, having a strongly acid taste and reaction, and a specific gravity of 1.077. It contains 10 per cent. of absolute acid.

Test.—It is readily distinguished from hydrochloric acid by the addition of chlorine water, which sets free the bromine.

It should be preserved in glass-stoppered bottles.

Inorganic Acids—(Continued).

Hydrochloric Acid.—Acidum Hydrochloricum, U. S.—This is also a haloid acid, and has the formula HCl.

Like hydrobromic acid, absolute hydrochloric acid is gaseous at ordinary temperatures, and it is the aqueous solution that is used in the arts, and it is that to which the name hydrochloric, or "muriatic," acid is applied. The pharmacopœial acid is composed of 31.9 per cent. of absolute acid and 68.1 per cent. of water.

Source.—The pure acid gas is obtained by treating pure Common Salt with pure Sulphuric Acid, according to the following equation :

$$\underset{\text{Sodium Chloride}}{NaCl} + \underset{\text{Sulphuric Acid}}{H_2SO_4} = \underset{\text{Sodium Sulphate (acid)}}{HNaSO_4} + \underset{\text{Hydrochloric Acid}}{HCl}.$$

and collecting the gas over mercury or by the displacement of air. The aqueous hydrochloric acid is obtained by passing the gas into water, the latter liquid absorbing it in large quantities.

Description and Properties : The gaseous hydrochloric acid is intensely irritating to the air passages, and strongly acid in its chemical reaction. It is condensable to a liquid at a temperature —4° C. and a pressure of 25 atmospheres. Its sp. gr., taking air as the standard, is 1.278.

The officinal aqueous hydrochloric acid is a colorless, fuming liquid, intensely acid to the taste and in its chemcal behavior, and possesses a pungent suffocating odor. Its sp. gr. is 1.16. Heated with black oxide of manganese it evolves chlorine, and in a solution of silver nitrate it produces a curdy white precipitate, which on exposure to light soon turns purple.

Uses : In the preparation of various officinal chlorides ; with nitric acid to form nitro-hydrochloric acid ; for generating chlorine ; and in promoting the precipitation of resins. It is sometimes administered internally, and is sometimes used externally for its irritant or caustic effects.

Also in the preparation of syrup of calcium lactophosphate ; solutions of : arsenious acid, iron chloride and zinc chloride.

Off. Prep.—Dilute Hydrochloric Acid.—Acidum Hydrochloricum Dilutum, U. S., consists of 6 parts of the officinal acid and 13 parts water, and contains 10 per cent. of absolute hydrochloric acid.

Hydrocyanic Acid.—HCN.—Acidum Hydrocyanicum. This perhaps is more correctly regarded as an organic acid, since its molecule contains an atom of carbon ; but it is more conveniently treated of here.

Source.—It occurs naturally in some vegetable structures, as in bitter almonds, cherry laurel, etc., but for the purposes of pharmacy it is obtained by distilling Ferrocyanide (prussiate) of Potassium with Sulphuric Acid and Water (hence also the name prussic acid) ; or it may readily be obtained from the cyanide of silver by agitating the salt with dilute hydrochloric acid.

Properties : Pure anhydrous hydrocyanic acid is a colorless, very mobile and volatile liquid, having the odor of bitter almonds. At the ordinary temperature of the air its specific gravity is .7. Its boiling point is 26.5° C., and at —15° C. it forms a mass of colorless, feathery crystals. It is soluble in water, alcohol and ether in all proportions, and both the liquid and its concentrated aqueous solution are readily inflammable.

The pure acid is one of the most deadly of poisons, and when taken internally so small a dose as .05 of a grain has been known to produce death. Its soluble salts are also for the most part highly poisonous. All preparations of it must be handled, therefore, with the greatest care.

Preparations.—Acidum Hydrocyanicum Dilutum, U. S., is the only officinal preparation, and contains 2 per cent. of Absolute Acid dissolved in 98 per cent. of a mixture of Alcohol and Water. As the acid is highly volatile, the solution will rapidly deteriorate unless kept in well stoppered bottles. The bottles should be small, with glass stoppers that are accurately ground, and they should be kept in a cool, dark place. It cannot even with these precautions be kept very long without deterioration, as the acid is slowly decomposed.

Uses : The officinal dilute acid has a restricted use in medicine, and may be given in doses of 2 or 3 minims.

Nitric Acid.—Acidum Nitricum, U. S.—This acid has the formula HNO_3, and is usually obtained by distilling the Nitrate of Sodium or Potassium with Sulphuric Acid. The reaction is represented by the following equation :

$$\underset{\text{Potassium Nitrate}}{KNO_3} + \underset{\text{Sulphuric Acid}}{H_2SO_4} = \underset{\text{Potassium Sulphate (acid)}}{KHSO_4} + \underset{\text{Nitric Acid}}{HNO_3}$$

the product thus obtained, even if the saltpeter used be thoroughly dried and the sulphuric acid strong, contains a small proportion of water, but the product, if the process is well conducted, may contain as high as 99.8 per cent. of the anhydrous acid.

Properties : The pure acid is a strongly fuming, very caustic and corrosive liquid, of a pungent, suffocating odor, and a strongly acid reaction. It rapidly absorbs moisture from the air, and on account of this and its corrosive properties must be kept in tight-fitting glass stoppered bottles. It acts powerfully on organic tissues, and colors such substances as horn, hair, skin, nails, wool and silk a bright yellow color. It acts energetically on copper, evolving in the process red fumes of nitrogen teroxide, and yielding a green solution of copper nitrate.

Uses : For dissolving various metals ; as an oxidizing agent ; for preparing certain nitrates ; in the preparation of nitrous ether and nitrate of amyl, and in medicine to some extent as a caustic.

Off. Prep.—Acidum Nitricum, U. S., contains of absolute Acid 69.4 per cent., and of Water 30.6 per cent. Its sp. gr. is 1.42.

Acidum Nitricum Dilutum, U. S., contains of officinal Acid 1 part, and Water 6 parts. Its percentage of absolute nitric acid is, therefore, 10 per cent.

Acidum Nitrohydrochloricum U. S., commonly called Aqua Regia, because of its power to dissolve gold ; is a mixture of nitric acid 4 parts, and hydrochloric acid 15 parts. It is sometimes used in the pharmaceutical laboratory as a solvent of certain metals, and in the manufacture of certain chlorides. Its solvent action on the noble metals is due to the chlorine which is set forth in the mixture.

Acidum Nitrohydrochloricum Dilutum, U.S., consists of Nitrohydrochloric Acid 19 parts and Water 76 parts.

Inorganic Acids—(Continued).

PHOSPHORIC ACID.

There are five different acids of phosphorus:

Hypophosphorous acid H_3PO_2.
Phosphorous acid H_3PO_3.
Orthophosphoric acid H_3PO_4.
Pyrophosphoric acid $H_4P_2O_7$, and
Metaphosphoric acid HPO_3.

Those of most importance to the pharmacist are metaphosphoric acid, or the so-called Glacial phosphoric acid, and Orthophosphoric acid.

Metaphosphoric Acid.—HPO_3—Glacial Phosphoric Acid.—This may be obtained from ordinary or orthophosphoric acid by heating it until water is no longer given off, according to the equation:

$$H_3PO_4 = HPO_3 + H_2O.$$

In practice, it is usually obtained by treating calcined bones with an equal weight of sulphuric acid diluted with 15 parts of water, filtering off the acid liquid, neutralizing it with ammonia, again filtering off the liquid portion from the precipitate, evaporating the filtrate to dryness and driving off the ammonia by heating to redness in a platinum crucible. The fused acid is now poured upon polished iron plates and when cool transferred to bottles. The acid thus prepared, though containing some sodium, is sufficiently pure for some of the purposes of pharmacy. The sodium phosphate may be gotten rid of by neutralizing the acid with ammonia, precipitating with barium chloride, washing thoroughly the precipitate of barium phosphate thus obtained with sulphuric acid, filtering and evaporating the filtrate, heating it to redness and pouring it out on polished iron plates to cool as before.

The presence of sodium phosphate causes the precipitate when the acid is mixed with solutions containing iron salts; the acid prepared from phosphorus, as it is termed to distinguish it from solutions of the glacial acid, as now prepared is usually free from sodium phosphate, and it should therefore be given the preference for dispensing purposes.

Orthophosphoric Acid.—H_3PO_4.—Phosphoric Acid, U. S.—The details of the process of manufacture are given in the Pharmacopœia, and need not be repeated here. It consists essentially in the oxidation of Phosphorus by means of Nitric Acid in presence of Water by aid of heat, and then driving off the excess of nitric acid and water by means of heat.

Properties. The pharmacopœial acid is a liquid composed of Orothophosphoric acid 50 per cent. and Water 50 per cent. It is colorless, odorless, with a strongly acid taste and reaction, a sp. gr. of 1.347, and when heated gradually loses water until when a temperature of about 200° C. is reached, decomposition occurs and it is converted first into a mixture of pyrophosphoric and metaphosphoric acids, and finally into metaphosphoric acid as stated above.

Tests.—Metaphosphoric and orthophosphoric acids are readily distinguished from each other when in solution, by the following tests: *Metaphosphoric* acid yields with nitrate of silver a transparent gelatinous precipitate, with barium and calcium chlorides white precipitates, and it has the property of coagulating albumen. *Orthophosphoric* acid, if ammonia be added, yields with nitrate of silver a yellow precipitate, does not form precipitates with either calcium or barium chlorides, and does not coagulate albumen.

For tests for arsenic and other impurities see U. S. P.

Off. Prep.—Acidum Phosphoricum Dilutum, U. S.—Consists of a mixture of officinal Phosphoric Acid 20 parts, with distilled Water 80 parts. It has a sp. gr. of 1.057 and contains 10 per cent. of the absolute acid.

Uses: In Syrup of the Phosphates of Iron, Quinine and Strychnine and several unofficinal preparations, such as Compound Solution of Phosphates, etc.

In all weak solutions containing an excess of phosphoric acid a fungoid growth is formed which can not be prevented except by the addition of a little hydrochloric acid; it may be retarded, however, by keeping such preparations in small, well filled bottles, in a dark place

SULPHURIC ACID.

Sulphuric Acid.—H_2SO_4.—Acidum Sulphuricum U. S.—This is the most important and useful of all acids; it is used in almost innumerable processes in the chemical arts; by means of it the great majority of the other acids are prepared; and its manufacture constitutes a very important branch of modern industry. In Great Britain alone not less than 850,000 tons of it are manufactured annually. The compounds of sulphuric acid or sulphates, too, are very numerous and important, some of them existing in nature and others being products of the laboratory.

Sources.—The acid may be obtained by the decomposition of certain sulphates, as Sulphate of iron, by means of heat, but in practice this process has been superseded by the less expensive one which consists essentially in bringing together in a leaden chamber the fumes of burning Sulphur, SO_2, Steam, and Nitrous fumes, NO_2. The reactions which takes place may be expressed by the following equations:

(1) $SO_2 + H_2O + NO_2 = H_2SO_4 + NO.$
(2) $NO + O = NO_2.$

The second equation expresses the fact that the NO_2 after yielding up one of its oxygen atoms as a contribution to the sulphuric acid molecule, takes up another from the air, and again becomes NO_2. The nitrous fumes thus acts as continuous carriers of oxygen from the air to the SO_2.

The nitrous fumes are generated by the action of Sulphuric Acid on crude Sodium Nitrate, and it is evident that a small quantity of the NO_2 will suffice for the production of a large quantity of Sulphuric Acid. The acid produced by this process is allowed to accumulate in the bottom of the leaden chamber until it acquires a specific gravity of 1.55 and contains about 64 per cent. of pure acid. This liquid, further concentrated in leaden evaporating pans until it acquires a specific gravity of 1.71 and contains 78 per cent. of real acid, constitutes the common brown oil of vitriol of commerce. Acid so highly concentrated as to contain 98 per cent. of the real acid may be obtained by evaporation in platinum or glass retorts.

Inorganic Acids—(Continued).

sulphuric acid—(continued).

Purification.—The product thus obtained not only contains two per cent. of water but also frequently arsenic derived from the sulphur ores used in generating the SO_2, and lead sulphate derived from the leaden chamber and evaporating pans of the same material.

To get rid of these impurities the commercial product is distilled in glass retorts until about one-third is passed over. The receiver is now changed and the remainder distilled nearly to dryness. The product thus obtained is free from the other impurities, but still contains about 2 per cent. of water which cannot be got rid of by distillation. If, however, the product be cooled, crystals of absolute acid will separate out and the liquid portion containing the uncombined water may be drained off.

Properties.—The pure crystalline acid thus obtained becomes liquid at 10.5° C., and at 0° C. has a sp. gr. of 1.854. The liquid, inodorous, colorless, and oily looking, has a strong acid reaction, and is intensely corrosive and caustic. It is miscible in all proportions with water and alcohol, and the mixture develops considerable heat. As it has a strong affinity for water, it chars or blackens many organic substances, as sugar, by abstracting from them the elements of water, especially when heated with them.

Impurities and their detection.—Some of the impurities sulphuric acid is likely to contain are mentioned above. The detection of these and other possible contaminations is fully described in the Pharmacopœia, which see.

Acidum Sulphuricum, U. S., should contain not less than 96 per cent. of absolute Acid and not more than 4 per cent. of water, and its sp. gr. should be at 0° not less than 1.84. It should be kept in close-fitting tight-stoppered bottles.

Off. Prep.—Acidum Sulphuricum Aromaticum, consists of Sulphuric Acid 200 parts, Tinct. of Ginger 45 parts, Oil of Cinnamon, 1 part, and Alcohol enough to make 1000 parts.

The directions given in the U. S. P. to *add the sulphuric acid gradually to 700 parts of alcohol* should be followed explicitly, for if the alcohol be added to the sulphuric acid, or if the sulphuric acid be added rapidly to the alcohol, accidents are liable to occur from the great heat developed. This preparation should have a sp. gr. of about .955 and contain about 20 per cent. of absolute acid.

Acidum Sulphuricum Dilutum, U. S., contains of Sulphuric Acid 1 part and Distilled Water 9 parts. It should contain of absolute acid at least 9.6 per cent. and of officinal acid 10 per cent. Its sp. gr. should be about 1.067.

Uses: In many pharmaceutical processes, as in the preparation of alkaloids, ether, pyroxylon, parchment, etc. Also in the manufacture of acids, such as acetic, nitric, citric and tartaric; having a strong affinity for bases, it unites with them when added to their salts and sets the weaker acid free—as for example, carbonic acid from carbonate of lime or soda in the making of "soda water." Also for decomposing certain organic compounds, as in purification of chloroform; and for forming sulphates.

Fuming Sulphuric Acid, or Nordhausen Acid, for some purposes in the arts is preferred to the ordinary acid. It consists of a mixture or perhaps a combination of the ordinary sulphuric acid, H_2SO_4 with sulphuric anhydride, SO_2, and is obtained by distilling in earthenware retorts basic Ferric Sulphate, $Fe_2S_2O_9$, the product of roasting common Green Vitriol, $FeSO_4+7H_2O$.

The chemical changes which take place are represented in the following equation: $Fe_2SO_9=2SO_3+Fe_2O_3$. Part of the SO_3 unites with the small amount of water that is still present, forming H_2SO_4 and the rest of the SO_3 becomes dissolved in it, forming a thick, oily, fuming liquid that has a sp. gr. of from 1.86 to 1.89.

Sulphuric Anhydride, SO_3, is a substance obtained by passing Sulphurous Anhydride. SO_2, mixed with Oxygen over platinum sponge or platinized asbestos heated to redness. It may also be obtained by distillation of Nordhausen Acid.

It exists in two modifications. One consists of transparent prisms which melt at 16° C., and on agitation solidifies at the same temperature. But if the liquid be not agitated it may be reduced to a much lower temperature before solidification takes place. If the melted prismatic crystals be permitted to stand at a temperature a little below 25° C., a mass of silky needles will be formed which do not melt at a temperature below 50° C. They change back to the first modification, however, when melted. In the second form SO_3 does not redden litmus paper (unless the latter be damp); it may be handled with impunity with dry hands, and does not attack the metals unless moisture be present. If thrown into water it hisses like a hot iron, great heat is developed and H_2SO_4 is formed. For convenience and transportation and on account of its purity, it has been proposed to manufacture it on a large scale for most purposes for which pure sulphuric acid is required.

Sulphurous Acid.—H_2SO_3.—Acidum Sulphurosum, U. S.—It is formed in many ways:

(1). When sulphurous oxide, SO_2, is brought into contact with water.

(2). When sulphur in burned in the air: $S+O_2=SO_2$.

(3). Certain metals, as copper, acted upon by sulphuric acid: $Cu+2H_2SO_4=CuSO_4+2H_2O+SO_2$.

(4). Sulphur and sulphuric acid heated together: $S+2H_2SO_4=3SO_2+2H_2O$.

(5). By the decomposition of a sulphite by sulphuric acid: $Na_2SO_3+H_2SO_4=Na_2SO_4+H_2O+SO_2$.

(6). By heating charcoal and sulphuric acid together: $C+2H_2SO_4=2H_2O+CO_2+2SO_2$.

It is the latter process which is adopted in the U. S. P. The gas thus obtained is passed through a wash bottle and collected in a bottle containing distilled water, in which it is dissolved.

Properties.—The pharmacopœial acid contains about 3.5 per cent. of the sulphurous oxide, and 96.5 per cent. of water. It is a colorless liquid, sp. gr. about 1.022, of a pungent, stifling odor, strongly acid taste and reaction, and first strongly reddens and then bleaches litmus paper.

Uses: In the manufacture of sulphites and as a bleaching agent in the arts; in medicine chiefly for its powerful antiseptic and disinfecting properties.

The Nitrogen Compounds.

Compounds of the Non-Metallic Elements.

Only those substances of most importance in pharmacy will be here described.

NITROGEN COMPOUNDS.

The most important of these are Ammonia and its compounds.

Ammonia, NH_3, is a gas, and may readily be obtained by heating any ammonia salt with an alkali, such as soda or potash, or an alkaline earth, such as lime. The following equation indicates the reaction :

$$2NH_4Cl + Ca(OH)_2 = 2NH_3 + CaCl_2 + 2H_2O.$$

Ammonium Chloride — Lime — Ammonia — Calcium Chloride — Water

Sal Ammoniac (muriate of ammonia) being cheap, is the salt usually used for the purpose, and in order to insure the complete decomposition of the salt an excess of lime is used.

Properties.—A colorless gas, with a pungent odor, strong alkaline reaction, and a sp. gr. (taking air as the standard) of 0.586. It neutralizes and forms stable compounds with the acids. All Ammonia compounds are completely volatilized by heat.

By cold and pressure it may be reduced to the liquid condition, when it forms a colorless, highly refractive, mobile liquid which boils at —33.7° C., and at —75° C. becomes converted into a crystalline solid. Liquid ammonia is quite extensively used as a substitute for, and in the manufacture of ice.

It is highly soluble in water, this liquid taking up, at O° C. and under the normal atmospheric pressure more than 1,100 volumes of the gas. The gas is probably not merely dissolved, but a portion enters into combination with water forming NH_4HO, or Ammonium Hydrate. This compound has, however, never been isolated.

Water of Ammonia.—Aqua Ammoniæ, U. S.—An aqueous solution containing 10 per cent. by weight of the gas. Is a colorless, transparent liquid of a very pungent odor, and a strongly acrid alkaline taste and alkaline reaction. Its sp. gr. at 15° C. is .959.

Off. Prep.—Linimentum Ammoniæ ; Spiritus Ammoniæ Aromatieus.

The strength of the weaker Ammonia water of commerce is usually designated by one or more F.'s, an arbitrary standard. The number of F.'s attached to a label usually does not indicate the percentage strength of the ammonia water contained in it. Although the mark of 4 F. is supposed to mean stronger water of ammonia, or 28 per cent., it usually indicates about 18 per cent.

Stronger Water of Ammonia.—Aqua Ammonia Fortior, U. S.—Contains 28 per cent. by weight of the gas. Its sp. gr. is .900. It should be kept in a cool place, in tightly stoppered bottles which are not quite filled, and care should be exercised in opening the bottles. (For tests see U. S. P).

Off. Prep.—Spiritus Ammoniæ.

Uses : As a precipitant in the preparation of many hydrates and salts, held in solution by acids, for example, ferric hydrate, calcium phosphate and most of the alkaloids. As a solvent in the extraction of some drugs and for neutralizing acid solutions. Combined with citric acid it forms double salts with some of the metals, as for example, bismuth and iron, rendering these soluble. It is also used as a general solvent for "grease" and in the preparation of many pharmaceutical products.

Ammonium Acetate.—$(NH_4)\ C_2H_3O_2$.—A solution made by saturating dilute Acetic Acid with Ammonium Carbonate, constitutes Liquor Ammonium Acetatis, U. S., or Spirit of Mendererus.

This preparation should always be prepared extemporaneously, since when fresh it is a most refreshing draught to feverish patients, while it rapidly loses its carbonic acid, and then possesses a disagreeable saline, frequently decidedly alkaline taste. The pure acid (U. S. P., not the commercial so-called No. 8) should be used, properly diluted, and the ammonium carbonate, in translucent pieces, gradually added with constant stirring, until only a slightly effervescence takes place. The solution is then poured in a vial, which must be well corked so as to preserve the carbonic acid. When administered, the preparation, owing to its sparkling character and pleasant acidity, forms a cooling and most agreeable potion. The U. S. P. also gives a second process for the preparation by keeping on hand a solution of the Ammonia carbonate to be mixed with the diluted acid.

Off. Prep.—Mistura Ferri et Ammonii Acetatis.

Ammonium Benzoate.—$(NH_4)\ C_7H_5O_2$.—Ammonii Benzoas, U. S.—A white crystalline salt having a slight odor of Benzoic acid, and a saline, bitter and highly acrid taste, made by saturating benzoic acid with ammonia and evaporating, keeping the ammonia in excess until crystals begin to form.

Ammonium Bromide.—NH_4Br.—Ammonii Bromidum, U. S.—A transparent crystalline or white granular salt, changing to yellowish on exposure to the air, and having a pungent saline taste.

It is prepared by agitating iron wire with a solution of bromine until the odor of bromine can no longer be perceived, adding solution of ammonia to excess, filtering and evaporating to dryness.

Uses : Mostly in the form of Elixir containing 10 grains to the fluid dram.

Ammonium Carbonate.—$(NH_4)HCO_3.(NH_4)(NH_2)CO_2$.—Ammonii Carbonas, U. S.—This salt is probably in reality a mixture of acid carbonate and carbamate of ammonium as expressed in the above formulas, instead of a true carbonate.

White, translucent masses, with odor of ammonia, and giving out both ammonia and carbon dioxide on exposure to the air. Taste saline, reaction alkaline. It must be kept in tightly closed jars, to protect it from the air.

Made by heating a mixture of Chalk and Ammonium Chloride. The Ammonium Carbonate sublimes and is collected in the cooler parts of the vessel, or in a receiver.

Uses : As an ingredient in "smelling salts," and in the two officinal preparations Liquor Ammoniæ Acetatis and Spiritus Ammoniæ Aromaticus. In conjunction with syrups of acid reaction, such as squill and glycyrrhiza for cough syrups the ammonium carbonate reacting with the acids should be gradually dissolved in a mortar, with the addition of water when permissible, so as to prevent frothing.

Compounds of Ammonium.

Ammonium Chloride.—NH_4Cl.—Ammonii Chloridum, U. S.—Muriate of Ammonia. In the crude state it occurs in tough, fibrous crystalline masses, but when pure more usually in a snow-white crystalline powder, with a cooling, saline taste, without odor, a slightly acid reaction, permanent in the air, and on heating with caustic potassa or lime, evolving ammonia gas.

Sources.—Made usually from the Ammoniacal Liquor of the gas-works by heating it with Lime and conducting the ammonia gas which is evolved into dilute Hydrochloric Acid until it is saturated. After evaporation and crystallization, the product is purified by sublimation. The crude unsublimed product is commonly called "Sal Ammoniac."

Uses: Commercial Sal Ammoniac usually contains variable quantities of iron, and is purified for medicinal use.

Ammonii Chloridum Purificatum, U. S., is obtained as a light granular powder by dissolving the crude muriate of ammonia or sal ammoniac in about twice its weight in hot water, adding a little chlorine water to convert any ferrous chloride present into a ferric salt, then ammonia in excess, which precipitates the iron present in the form, of ferric hydrate. The liquid is then filtered, and the clear filtrate evaporated until a pellicle forms, when it is allowed to cool and crystallize; or it may be evaporated nearly to dryness in a shallow vessel, and the granular, crystalline powder dried between sheets of filter paper. Its preparation is well adapted to the beginner as the first chemical to be made in the pharmacy.

Off. Prep.—Trochisci Ammonii Chloridi.

Ammonium Iodide.—NH_4I.—Ammonii Iodidi, U. S.—A white, granular, deliquescent salt, changing to yellow or yellowish-brown on exposure to the air, odorless when white but with a faint odor of iodine when colored by exposure; a sharp saline taste, and a neutral reaction. It is prepared by saturating Ammonia Water with Hydriodic Acid.

Uses: A spirit, prepared by mixing an alcoholic solution of iodine with strong ammonia water in such proportion as to yield a colorless product, consisting of ammonium iodide and ethyl iodide. This has been erroneously termed "decolorized tincture of iodine." [For formula see the Dispensatory and National Formulary.]

Ammonium Citrate.—Made by saturating a solution of Citric Acid with Water of Ammonia so as to be of a faint alkaline reaction, recognized by a slight odor of ammonia.

Uses: As a solvent for many salts especially in Elixirs; with iron and bismuth it forms soluble double compounds viz.: ammonio-citrate of iron and ammonio-citrate of bismuth. These will be treated under their respective metals.

Ammonium Nitrate.—NH_4NO_2.—Ammonii Nitras, U. S.—Colorless, usually rhombic prismatic crystals, somewhat deliquescent, odorless, with a sharp bitter taste and neutral reaction. Dissolves at the ordinary temperature in half its weight of water and in 20 parts of alcohol, and is much more freely soluble in both at their boiling points. Completely resolved by heat into nitrous oxide (laughing gas) and water.

Made by saturating dilute Nitric Acid with Ammonia Water or with Ammonium Carbonate.

Uses: In dentistry for the production of "Laughing Gas."

Ammonium Oxalate, made by saturating a solution of Oxalic acid with Ammonia, and crystallizing. It is of importance in pharmaceutical chemistry as a test for calcium, and the Test Solution is officinal.

Ammonium Phosphate.—$(NH_4)_2HPO_4$.—Ammonii Phosphas, U. S.—Colorless, translucent, prismatic crystals, evolving ammonia on exposure to air, odorless, possessing a cooling saline taste, and neutral or slightly alkaline reaction.

Made by adding an excess of Ammonia Water to dilute Phosphoric Acid, and evaporating slowly until crystals form.

Ammonium Sulphate.—$(NH_4)_2SO_4$.—Ammonii Sulphas, U. S.—Colorless, transparent, rhombic prisms, permanent in air, odorless, possessing a sharp saline taste, and neutral reaction. Soluble in 1.3 parts of water at 15°, insoluble in absolute alcohol.

Made by heating the ammoniacal Gas Liquor with Lime and conducting the ammonia gas evolved into dilute Sulphuric Acid, evaporating and crystallizing.

This and ammonium chloride constitute the principal sources of the other ammonium compounds.

Ammonium Sulphide.—A solution made by saturating water of ammonia with hydrogen sulphide. It is of importance in pharmaceutical chemistry as a test, and the solution is officinal.

Ammonium Valerianate.—$(NH_4)C_5H_9O_2$.—Ammonii Valerianas, U. S.—White or colorless, tabular crystals, deliquescent in moist air, possessing the peculiar odor of valerianic acid, a sharp, sweetish taste and a neutral reaction. Freely soluble in both water and alcohol.

Made by passing dry Ammonia Gas into Valerianic Acid when the salt crystallizes out. On a large scale, however, it is prepared from Fusel Oil (amylic alcohol) which bears the same relation to valerianic acid as ordinary alcohol bears to acetic acid, and like the last named alcohol is converted into its respective acid by oxidation.

Uses: Principally in the form of Elixirs containing two grains to the fluid dram. Solutions of the salt must be carefully neutralized with ammonia so as to prevent the volatilization of the acid, to which the disagreeable odor is due. [See National Formulary].

Boron.—Bromine.—Carbon.

Boron.

Boron does not occur in the free state in nature, but is found combined with oxygen and hydrogen to form Boric Acid (already described), and also in the form of certain salts of this acid, the most important of which is Borax.

Boron is obtained in two Allotropic forms, one *crystalline*, the other *amorphous*.

The first form consists of monoclinic, octahedra or prisms, which have a luster and hardness exceeded only by the diamond. Their sp. gr. is 2.68.

The second form is a dark brown, tasteless and odorless powder, but slightly soluble in water, a very bad conductor of electricity, and fuses only at a very high temperature.

Neither of these are used in pharmacy. They are rather rare and expensive products of the chemical laboratory.

Compounds of Boron.

Aside from Boric Acid, already described, the only compound of boron of importance in pharmacy is the following:

Borax.—$Na_2B_4O_7+10H_2O$.—Sodii Boras, U. S.

In crystalline, transparent, shining, colorless, somewhat efflorescent crystals, having a mild, cooling, and somewhat alkaline taste and reaction. Soluble in 16 parts of water at 15° C. in one part of glycerin at 80° C., insoluble in alcohol; when heated parting with its water of crystallization, first swelling up into a porous mass and then fusing into a transparent glass.

Uses: In various analytical operations in the laboratory, and in medicine, as ingredient of detergent antiseptic washes such as the Glycerite of Borax, and Honey of Borax, both formerly officinal. Borax is largely used in the powdered form to destroy cockroaches, etc. In the form of Boro glyceride (see Acid Boric, page 94), it is used extensively as an antiseptic dressing, and to preserve meats and vegetables.

Bromine.

Bromine is not found free in nature, but its compounds are not uncommon, occurring in combination with sodium, potassium, silver, calcium, magnesium, etc. It occurs in Sea-Water and in the waters of many saline springs. It is usually obtained by concentrating the mother liquors containing its salts and treating them with Chlorine, which displaces the Bromine from its compounds, as represented in the equation:

$MgBr_2$	+	Cl_2	=	$MgCl_2$	+	Br_2.
Magnesium bromide		Chlorine		Magnesium chloride		Bromine.

Properties.—It is a heavy, mobile, very volatile liquid, with a disagreeable, pungent odor, the vapors when inhaled producing great irritation of the air passages. Its sp. gr. at 0° C. is 3.1872. At—22° C. it solidifies to a reddish brown solid, and it boils at 63° C. The compounds of bromine closely resembles those of chlorine and iodine.

Uses: Rarely in medicine as an external application and as an antiseptic.

Bromine must be preserved in small, tightly-fitting glass-stoppered bottles, usually kept in a tin box, and packed in plaster Paris. Even with these precautions the whole contents of a vial have been known to escape, owing to its great volatility.

The compounds of bromine of importance in pharmacy are treated of under other headings.

Carbon.

This element exists in three modifications, diamond, graphite and charcoal. The two former are of but slight importance in pharmacy, but Charcoal, on account of the property it possesses of condensing large quantities of oxygen and other gases on the surface of its particles, has important uses. By virtue of this property it absorbs the foul-smelling gases produced by the decay of organic matter and causes their oxidation, bleaches solutions containing organic coloring matter, etc.

Animal Charcoal.—Carbo Animalis, U. S.—This is prepared by burning the bones of Animals with a limited supply of Air.

It is sold in the form of dull black angular fragments, or in the form of a dull black powder. When a portion of it is ignited in the open air, a white residue, called bone-ash, remains. This ash constitutes about 86% of the weight of the charcoal and should be completely soluble in hydrochloric acid with the aid of heat.

Purified Animal Charcoal.—Carbo Animalis Purificatus, U. S.—Consists of ordinary animal charcoal from which the Bone-Ash has been removed by means of Hydrochloric Acid, leaving the nearly pure carbon residue.

Wood Charcoal.—Carbo Ligni, U. S.—This is prepared by burning Wood with a limited supply of Air, until all the volatile portions have been driven off or consumed.

For pharmaceutical purposes that prepared from *soft* wood is preferred.

Carbon Compounds.

These are very numerous and important. All organic compounds come under this head and many of the so-called mineral compounds. The organic compounds, carbon dioxide, carbonic acid, and some of the carbonates have already been treated of; the other carbonates of importance in pharmacy will be treated of under their respective metals. It remains to mention here only the following:

Bisulphide of Carbon.—CS_2. Carbonei Bisulphidum, U. S.—or Carbon Disulphide, as it is more correctly termed. A clear, colorless, strongly refractive, very volatile and inflammable liquid, having a strong, disagreeable odor and a sharp aromatic taste. It is completely insoluble in water, and its sp. gr. is 1.272. It is prepared by adding Sulphur to Charcoal heated to redness, and condensing the vapor.

It has anæsthetic properties, but its principal pharmaceutical uses are as a solvent; caoutchouc, iodine and some other substances, almost insoluble in ordinary solvents, being readily soluble in it.

Chlorine—Iodine.

Chlorine.

Chlorine does not occur in a free state in nature, but its compounds are numerous and important.

Preparation.—It is readily obtained by the reaction of Hydrochloric Acid on Manganese Dioxide, as represented in the following equation:

$$\underset{\text{Hydrochloric acid}}{4HCl} + \underset{\text{Manganese dioxide}}{MnO_2} = \underset{\text{Chlorine}}{Cl_2} + \underset{\text{Manganese chloride}}{MnCl_2} + \underset{\text{Water.}}{2H_2O}$$

It can also be obtained in many other ways.

Properties.—Chlorine is a greenish color, disagreeable odorous gas, 2.45 times as heavy as air, and under a pressure of 6 atmospheres at 0° C. convertible into a yellow liquid having a sp. gr. of 1.33. The gas dissolves in about half its volume of cold water, unites with great energy with hydrogen to form hydrochloric acid, and owing to its strong affinity for hydrogen is a powerful bleaching agent.

Preparations.

Chlorine Water.—Aqua Chlori, U. S.—Is a solution of Chlorine Gas in Distilled Water, and should contain not less than 0.4 per cent. of the gas. (For preparation see U. S. P.)

Uses: As reagent in the pharmaceutical laboratory, and in medicine for its antiseptic virtues.

Chlorinated Lime.—Calx Chlorinata, U. S.—Also wrongly called "chloride of lime," is a compound produced by the action of Chlorine on caustic Lime. It has the odor of chlorine, and is a valuable bleaching agent, disinfectant and antiseptic. As is well known, it should not be exposed to the air.

Solution of Chlorinated Soda.—Liquor Soda Chloratæ, U. S.—(Labarraque's Solution), is prepared by dissolving 100 parts of Sodium Carbonate in 400 parts of Water, mixing in a separate vessel 80 parts of Chlorinated Lime with 400 parts of Water, mixing the two solutions, adding sufficient Water to make 1,000 parts, straining the mixture, allowing the precipitate to subside, and drawing off and bottling the clear liquid.

Properties.—Clear, pale-greenish liquid, sp. gr. 1.044, odor of chlorine, disagreeable alkaline taste, and acting as a bleaching agent upon vegetable coloring matters.

Uses: As a reagent in the pharmaceutical laboratory, and in medicine as a disinfectant and antiseptic, and as a bleaching agent, for the removal of fruit stains, etc.

Chlorine is the most efficient, as it is the most powerful of all disinfectants. It is also the cheapest, and in the form of a good article of chlorinated lime leaves nothing to be desired for all purposes of a general disinfectant and deodorizer.

The other compounds of chlorine that are of importance in pharmacy are elsewhere considered.

Iodine.

Like chlorine and bromine, this element does not occur free in nature, and its compounds, though rather widely diffused, do not occur in great abundance. Its salts occur in the Ashes of marine plants, in certain marine animals, and in solution in small quantities in Sea-Water. It occurs also in combination with silver, lead, and in Saline Waters in combination with sodium, magnesium and potasium.

Sources.—It is principally obtained from "kelp" or the ashes of sea-weeds, by lixiviating them, concentrating the solution, and after the alkaline carbonates, sulphates and chlorides have been removed by crystallization, the iodine is obtained by distilling the mother liquor with Sulphuric Acid and Manganese Dioxide, the decomposition which takes place being represented by the following equation:

$$\underset{\text{Sodium iodide}}{2NaI} + \underset{\text{Sulphuric acid}}{3H_2SO_4} + \underset{\text{Manganese dioxide}}{MnO_2} = \underset{\text{Iodine}}{I_2} + \underset{\text{Sodium sulphate (acid)}}{2NaHSO_4} + \underset{\text{Manganese sulphate}}{MnSO_4} + \underset{\text{Water}}{2H_2O}$$

Properties.—Dark, lustrous, opaque crystals, belonging to the rhombic system. Sp. gr. 4.948 at 27° C. Fusing point between 113° and 115° C.; boiling point about 200° C., when beautiful violet vapors are given off. Iodine sublimes slowly at ordinary temperatures, and a crystal laid upon the skin imparts a characteristic brown color.

The following preparations of iodine are official:

Liquor Iodi Compositus, a solution containing Iodine 5 parts, Potassium Iodide 10 parts, and distilled Water 85 parts.

Unguentum Iodi, a mixture of Iodine 4 parts, Potassium Iodide 1 part, Water 2 parts, and Benzoinated Lard 93 parts.

Tinctura Iodi.—Iodine 8 parts, Alcohol 92 parts.

Amylum Iodatum.—Starch 95 parts, Iodine 5 parts, Water to make 100 parts.

Compounds of Iodine.

Iodoform.—CHI_3.—Idoformum, U. S.—It is formed by the action of Iodine upon Alcohol, Ether and various compounds of the ether series, in the presence of one of the fixed Alkalies or Alkaline Carbonates.

Properties.—Small lemon-yellow, hexagonal crystals in the form of thin, lustrous scales. They are unctuous to the touch, with an odor resembling Saffron, and a peculiar sweetish and unpleasant iodine-like taste. But slightly soluble in water, soluble in 80 parts of alcohol, a sp. gr. of 2. and, like iodine, volatilizes slowly at ordinary temperatures.

Off. Prep.—Unguentum Iodoformi.

Uses: Principally in the officinal ointment by substituting petrolatum for benzoinated lard. Also in the form of powder as an external application. The odor may be partially masked by the addition of 4 per cent. of thymol, menthol or coumarin. (See National Formulary).

The other compounds of iodine which are of importance pharmaceutically are treated of under other headings.

Phosphorus.—Sulphur.

Phosphorus.

This element is not found free in nature, but certain of its compounds are rather abundant. It exists in the bones of animals in the form of Calcium Phosphate, and these constitute its principal commercial source.

It is known in two Allotropic forms:

Phosphorus.—Phosphorus, U. S.—Is a transparent nearly colorless or yellowish, highly refractive body that crystallizes in octahedrons, and at 15° C. has about the consistency of wax. Its sp. gr. is 1.83, it melts at 44.3° C. (111.2° F.); when heated in atmosphere free from oxygen, it boils at 290° C., yielding a colorless vapor. It is almost insoluble in water, sparingly soluble in alcohol, more soluble in boiling absolute alcohol, slightly soluble in the volatile oils and ether, freely soluble in carbon disulphide, and in about 50 parts of any fixed oil.

Owing to slow oxidation, it is luminous in the dark, even at ordinary temperatures, but does not inflame until heated to slightly above its melting point. The compounds of phosphorus of pharmaceutical importance are elsewhere considered.

It is obtained by distilling a mixture of Calcium Metaphosphate and Charcoal heated to redness, when the Phosphorus is liberated, and escaping as vapor is collected under Water, condensed and, after redistillation to free it from impurities, is formed into cylindrical sticks.

By exposure to the air it soon loses its transparency and becomes "corroded" or covered with a white coating, which is also true when kept under water, not entirely free from air.

Red or Amorphous Phosphorus is obtained by the action of heat and light on the ordinary form. The change takes place at a temperature between 240 and 250° C. If, however, red phosphorus be heated to a temperature of 260° C., it changes back to the ordinary form.

Red phosphorus has a reddish brown color, and when in powder resembles pulverized iron oxide. In the massive form it has a conchoidal fracture, is much harder than ordinary phosphorus, undergoes no change either when exposed to the air, or when taken into the alimentary canal of an animal, and hence is not poisonous, and it does not take fire at any temperature below 240° C. The commercial product, now extensively used for the manufacture of matches, is usually more or less contaminated with ordinary phosphorus.

Two other modifications of phosphorus are known, but those already described are the ones most commonly used.

Off Prep.—Pilulæ Phosphori (each pill containing 1-100 gr. of phosphorus); Oleum Phosphoratum.

Uses: For internal administration Phosphorus should be largely diluted with an excipient or vehicle, as in the Pharmacopœial processes for the two above preparations respectively. For the unofficinal Spirit and Tincture see National Formulary.

Phosphorus, owing to its inflammable character, must always be kept in a strong bottle and be well covered with water. In order to prevent accidents, which may occur by the accidental fracturing of the bottle, in should be placed in a stone jar in a safe location. The same precaution is necessary to observe in dispensing it, especially to guard against exposing it even for a short time without being covered with water, or mixed with some other substance serving to exclude the air.

Sulphur.

This is an abundant element in nature, occurring both free and in combination with various metals. Sulphur in a very pure form is found throughout the Rocky Mountain region, but the larger proportion of the sulphur used in medicine comes from the neighborhood of Mt. Ætna. It is usually more or less mixed with earth, but is purified by fusion or sublimation.

Roll Sulphur or brimstone is prepared by pouring the melted sulphur into moulds.

Sublimed Sulphur.—Sulphur Sublimatum, U. S.—Also called "flowers of sulphur," is obtained by volatilizing the sulphur and condensing it in a large chamber. It usually contains a small quantity of sulphuric acid, and sometimes also arsenious sulphide as impurities.

Sulphur is insoluble in water, slightly soluble in hot, absolute alcohol, ether, chloroform and benzol, depositing upon cooling in the form of crystals. It is soluble in hot aqueous solutions of the alkalies and alkaline earths, forming sulphides and very soluble in carbon disulphide.

Preparations.

Sulphur Ointment.—Unguentum Sulphuris, U. S.—30 parts Sulphur to 70 parts Benzoinated Lard.

Washed Sulphur.—Sulphur Lotum, U. S.—Prepared by washing sublimed sulphur thoroughly, first with Water of Ammonia and then with Distilled Water to remove the above-named impurities.

Off Prep.—Pulvis Glycyrrhizæ comp.; Unguentum Sulphuris Alkalinus, and Sulphuris Iodidum, prepared by fusing a mixture of one part of Sulphur to four parts Iodine, in a flask, to a homogeneous mass.

Precipitated Sulphur.—Sulphur Præcipitatum, U. S.—Is prepared by heating together freshly slaked Lime, sublimed Sulphur and Water to make a solution of Calcium Sulphide, then adding Hydrochloric Acid to precipitate the sulphur, collecting, thoroughly washing and drying the precipitate.

This article is found in commerce, Lac Sulphur, as it is termed, consists largely of calcium sulphate, owing to the fact that sulphuric acid, instead of hydrochloric acid, is employed to precipitate the sulphur.

Sulphur Compounds.

These are very numerous, and many of them are of importance in pharmacy, but as most of them are treated of elsewhere in these lectures, only the following will be mentioned here:

Hydrogen Sulphide.—H_2S.—Or Hydrosulphuric Acid.—This is a gas with a disagreeable odor as of decayed eggs, soluble in water, poisonous when respired in the concentrated form, and blackening paper which has been soaked in solution of lead acetate.

It precipitates many of the metals from solution as *sulphides*, and is therefore valuable as a reagent in pharmaceutical chemistry, the Solution being officinal.

Hydrogen Sulphide or "Sulphureted hydrogen," as it is most frequently termed, is given off when some metals are dissolved in acids, as in the preparatisn of solutions of the chlorides of iron, zinc, etc., owing to the presence of Sulphur as an impurity.

Questions on Lecture VIII.---Series 8.

1. What are the chief constituents of the "Refrigerant Drugs"?
2. What are their therapeutic properties?
3. What is the best *general* menstruum for their extraction?
4. What is meant by Reactionary Drugs? What *conditions* are necessary to develop their activity?
5. Does *dry* Mustard Seed contain Volatile Oil of Mustard?
6. Why is Wild Cherry bark directed to be macerated with water prior to percolation?
7. What relation do Neutral Principles sustain to Glucosides?
8. What is the principal Constituent of Aloes, and in what proportion is it contained in the official variety?
9. Define a Glucoside. What *term* does the U. S. P. apply to Glucosides?
10. What is Ergot? What are its officinal preparations?
11. What is the principal use of Goa Powder?
12. Mention several officinal drugs containing berberine.
13. Why would an *alcoholic* preparation of Senna be medicinally *inert?* What is the preferable menstruum for its extraction?
14. Define an Alkaloid.
15. Mention several Drugs containing an Alkaloid.
16. What terminations have been adopted by the U. S. P. to distinguish the names of the Glucosides and Alkaloids?
17. Mention several *general* Tests for the Alkaloids.
18. Give a general process for the isolation of alkaloids.
19. What is the *general* Menstruum for all Preparations of Opium?
20. What is the *percentage* of Morphine in the officinal Deodorized Tincture of Opium?
21. What *requirements* should the officinal Cinchona Barks possess?
22. If Nux Vomica contains one-half of one per cent of Strychnine, how much *strychnine* will ten grains of the Extract contain?
23. What is Pepsin? What is the officinal variety?
24. In what *kinds* of Solutions is the *activity* of Pepsin impaired?
25. In what manner is the *strength* of Pepsin determined?
26. What is the *difference* between Pepsin and Peptone
27. What is Pancreatin, and what uses does it serve in Pharmacy and Medicine?

IMPORTANT.

Students will please reply to the above questions on *letter-size* paper, (not note) *in ink*, as briefly as possible and without copying the lecture. Write plainly, on *one* side of the paper only (which must be signed, or no notice can be taken of it), and forward promptly to the Director. In answering it is *not* necessary to repeat the question itself, but only the *number* of each question.

National Institute of Pharmacy.

LECTURES, SEMI-MONTHLY, BY MAIL.
C. S. HALLBERG, Ph. G., *Director.*

DEPARTMENT OF EXAMINATIONS.

CHICAGO, Oct., 1891.

C. F. Carpenter, East Hampton, Conn.

Upon Questions on Lecture IX., Series 7, we transmit the following printed answers for further comparison and study:

1. Refer to lecture.
2. Refer to page 45.
3. The Hydrogen of Inorganic Acids is entirely replaceable and consequently indicates the basicity; this is not true of Organic Acids.
4. A Mono-basic Acid has one atom of hydrogen, a Di-basic, two of them, replaceable by a base.
5. It dissolves slowly and the solubility varies with the condition; being an oxide, it is soluble in acids and alkalies.
6. Ferric Hydrate, recently precipitated.
7. About $\frac{1}{20}$ gr.
8. It is too potent an Oxidizer.
9. Oxidation takes place so rapidly that the alcohol becomes ignited and the acid is converted to a green chromium oxide.
10. Hydrochloric Acid.
11. Sulphuric Acid.
12. *a.* Dilute Hydrocyanic Acid. *b.* 2 per cent. of absolute Acid. *c.* 1 to 5 minims.
13. Sulphurous Acid.
14. As an oxidizing agent chiefly, also as a solvent of metals.
15. Nitrohydrochloric and other Acids, Chlorine, Potassium Chlorate and Permanganate, etc.
16. Orthophosphoric Acid is the designation or name.
17. ———
18. Stir the water briskly and continuously in an open vessel while adding the acid in a thin stream.
19. Refer to lecture.
20. Gas liquor.
21. 10 and 28 per cent.
22. By Volumetric Analysis.
23. To precipitate the Iron Compounds present in crude Ammonium Chloride.
24. It contains iodides of sodium and ammonium, a sulphur compound of sodium, alcohol and water.
25. 0.4 per cent.

Your rating on answers to Lecture 9 *is* 91 *per cent.*

The abbreviations "P.," "Col." and Par.," are used to indicate "page," "column," and "paragraph," respectively.

In rating the answers, your *general understanding of the subjects* and the *appearance of your paper*, are also taken into consideration.

☞ The above questions should be *carefully reviewed* upon receipt of corrections. If questions to any other Lectures remain unanswered, please send them in at once.

THE DIRECTOR.

Always continue to answer in the regular order without waiting for delayed observations. Corrections are always forwarded as promptly as possible.

☞ **NOTICE.—Do not fail to write your name, full address and CLASS page** 627 **, at the TOP of the first page of your answers.**
In all correspondence the CLASS page must be stated in order to insure prompt attention.

Compounds of the Metals.

POTASSIUM.

Potassium belongs to the Alkali group of metals, which includes also Sodium, Lithium, Rubidium and Cæsium.

Sources.—Although potassium does not occur free in nature, it is a widely distributed and rather abundant metal. It occurs in many silicates, as Feldspar, Leucite, etc.; as chloride in certain localities, as at Stassfurt, Germany, and also in solution in small proportion in Sea-Water, and in the waters of certain mineral springs; in the form of Nitrate in various soils, and in other combinations in most soils; and in the tissues of land plants.

Preparation.—It is obtained in the metallic form by heating to a white heat a mixture of Charcoal and Potassium Carbonate, and rapidly cooling the vapor of potassium as it escapes from the crucible, by conducting it into a properly constructed receiver. The following equation represents the reaction which takes place.

$$K_2CO_3 + 2C = K_2 + 3CO.$$

It may also be prepared on a small scale by the electrolysis of Potassium Cyanide.

Properties: A silvery white metal, sp. gr. 0.875, brittle, and possessing a crystaline fracture at 0° C., but of a waxy consistency, and easily cut at 15° C., melting at 62.5° C., oxidizes readily on exposure to damp air, and with such rapidity when thrown upon water that the hydrogen set free from the latter is inflamed and is colored a characteristic violet by the volatilized potassium oxide, which is produced. It must be preserved under naphtha, or some other fluid that does not contain oxygen.

Uses: Being a powerful reducing agent, it has some important uses in the chemical laboratory, but has no pharmaceutical importance. Several of its compounds, however, are of great importance.

POTASSIUM COMPOUNDS.

Caustic Potassa.—KHO.—Potassa, U. S.—Potassium Hydroxide. Usually obtained by decomposing a solution of Potassium Carbonate by means of freshly slaked Lime. It is commonly sold in sticks or pencils, which are hard, white, very deliquescent, very caustic to the taste, and strongly alkaline in their reaction. At 15° C. it is soluble in one-half its weight of water, and in twice its weight of alcohol.

Preparations: Liquor Potassa, containing Potassa 56 parts, and Distilled Water 944 parts; Potassa cum Calce, made by rubbing together equal parts by weight of Potassa and Lime; and "Potassa by alcohol," prepared by precipitating the impurities from a solution of the commercial Potassa with Alcohol.

Sulphurated Potassa.—Potassa Sulphurata, U. S.—Not a definite compound, but a mixture of several, produced by gradually heating a mixture of Sublimed Sulphur, 1 part, and Potassium Carbonate, 2 parts, until effervescence ceases, and cooling the fused mass by pouring it out on a marble slab.

It is, when fresh, composed chiefly of potassium trisulphide and potassium hyposulphite, but usually contains also a small percentage of unchanged potassium carbonate. It rapidly undergoes change, on exposure to the air, and must be kept in tight-fitting, glass-stoppered bottles.

Properties: Liver-colored masses, changing to greenish-yellow or brownish-yellow on exposure; odor faint, disagreeable, resembling sulphureted hydrogen; taste bitter, alkaline and repulsive.

Uses: In the preparation of Lotions, Ointments, etc., for diseases of the skin or mucous surfaces. Now seldom used internally.

Potassium Acetate.—$KC_2H_3O_2$.—Potassii Acetas, U. S.—Made by saturating a solution of Potassium Carbonate with Acetic Acid, and evaporating the solution until crystals are formed.

Properties: Deliquescent, crystalline or granular white salt, without odor, and having a mildly pungent and saline taste. Soluble in 4 parts of water and 2.5 parts of alcohol, melts to an oily liquid at a temperature of about 280° C., and at a higher temperature is decomposed, evolving acetic acid, acetone and other volatile products, and leaves potassium carbonate and charcoal.

Uses: In medicine as a diuretic and diaphoretic.

Potassium Arsenite, solution.—Liquor Potassii Arsenitis, U. S.—Fowler's Solution.

Made by boiling 1 part of Arsenious Acid, and 1 of Potassium Bicarbonate, in 10 parts of Water, until solution is complete, and then adding Compound Tincture of Lavender 3 parts, and Water enough to weigh 100 parts.

Potassium Bicarbonate.—$HKCO_3$. Potassii Bicarbonas, U. S.—Obtained from the Carbonate by saturating a solution of the latter with Carbon-Dioxide, filtering, evaporating, and allowing the liquid to crystallize.

Properties: Transparent, colorless, monoclinic prisms, permanent in dry air, without odor, taste saline and somewhat alkaline. Heated to about 200° C., it gives off water and carbon-dioxide, and is converted into carbonate of potassa. An impure variety, in the form of a white powder, was formerly sold under the name of Salæratus.

Uses: In many saline draughts, when of acid reaction to furnish carbonic acid by decomposition. For that purpose it is used in the officinal Solution of Magnesium Citrate.

Potassium Bichromate.—$K_2Cr_2O_7$.—Potassii Bichromas, U. S.—Obtained from Chrome-ironstone, $FeOCr_2O_3$, by roasting it, heating it strongly with Potassium Carbonate and Lime, leaching out the Potassium Chromate thus formed, and converting it into the Bichromate by treating the solution with Sulphuric Acid.

Properties: Garnet-red tables or prisms, odorless, with an unpleasant, bitter, metallic taste, and an acid reaction. Sp. gr. 2.692, soluble in 10 parts of water at 15° C., fusible below red heat into a transparent, red liquid, and decomposes at a white heat into oxygen, normal chromate, and chromic oxide.

Uses: As a test in pharmaceutical chemistry (see the officinal Test Liquid), in the preparation of Chromic and Valerianic acids. Also in dyeing, and with sulphuric acid for coloring liquids in "show bottles." Internally in large doses it is poisonous, chalk, magnesia or soap being the proper antidotes.

Normal Potassium Chromate, or yellow chromate of potash, K_2CrO_3. This occurs in six-sided, lemon-yellow crystals, and is usually prepared by adding Potassium Carbonate to a solution of the Bichromate so long as effervescence is produced.

Uses: Chiefly for the preparation of test solution in pharmaceutical chemistry.

Potassium Compounds—(Continued).

Potassium Bitartrate.—$KHC_4H_4O_6$.—Potassii Bitartras, U. S.—Cream of Tartar. Prepared from Argols, or argol, a crystalline deposit formed in grape-juice during the vinous fermentation. It consists of Cream of Tartar associated with Tartrate of Calcium and other impurities. The crude product is purified by repeated crystallization.

Properties: Either in colorless or nearly colorless rhombic crystals, or a white, gritty powder, odorless, pleasantly acid to the taste, and having a acid reaction. It blackens when strongly heated, and gives out the odor of burnt sugar.

As the salt is very liable to adulteration, the pharmacopœial tests for purity should always be applied to samples purchased for medicinal use.

Uses: As the source of Tartaric Acid, and in the preparation of Tartrate of Antimony and Potassium, Tartrate of Iron and Potassium, Tartrate of Sodium and Potassium, and Tartrate of Potassium.

In medicine as a laxative, refrigerant and diuretic. Mixed with some dry powder, such as Starch; in conjunction with Sodium Bicarbonate, it is largely used as Baking-powder. The carbonic acid by exposure to moisture and heat is liberated in the process of baking, thus rendering the bread light and porous.

Preparations.—In Pulvis Jalapæ Compositus; Beach's Diaphoretic Powder, and as an ingredient in many unofficinal mixtures. Popularly as a blood purifier mixed with flowers of sulphur.

Potassium Bromide.—KBr.—Potassium Bromidum, U. S.—Obtained by the reaction of Potassium Carbonate upon a solution of Ferrous Bromide, according to the following equation:

$$FeBr_2 + K_2CO_3 = 2KBr + FeCO_3.$$

Properties: Colorless, cubical crystals, permanent in dry air, odorless, with a saline taste, and neutral reaction. Soluble in 1.6 parts of water and 200 parts of alcohol at 15°C., and at a dull red heat fuses, without loss of weight.

Uses: As a sedative, anæsthetic and hypnotic.

Preparations.—In various unofficinal preparations: Elixir, containing 10 grains to the fluid dram, and in a compound mixture of Potassium Bromide and Chloral, containing 15 grains of each in one fluid dram, and $\frac{1}{8}$ grain each, extracts cannabis Indica and extract hyoscyamus. (See Nat. Form.)

Potassium Carbonate.—$(K_2CO_3)_2 + 3H_2O$.—Potassii Carbonas, U. S.—Salts Tartar.

Sources.—Obtained by leaching Wood-Ashes and evaporating the lye thus obtained and purifying it; also from Potassium Sulphate which occurs in sea-water, and as mineral in some localities.

Properties: White granular powder, or in white solid masses, odorless, with a somewhat caustic and alkaline taste, and alkaline reaction. It is highly deliquescent, at 15°C. is soluble in 1 part of water, but is insoluble in alcohol.

Uses: It is employed in pharmacy in preparing Atropine, Sulphureted Potassa, Compound Decoction of Aloes. In medicine it is used externally on account of its irritant or caustic effect, and internally as an antacid and diuretic. In large doses an irritant caustic, the proper antidote being dilute acids, such as vinegar.

Off. Prep.—Unguentum Sulphuris Alkalinum.

Potassium Chlorate.—$KClO_3$.—Potassii Chloras, U. S.—Usually obtained by the action of Chlorine on a solution of Caustic Potash, or on a moistened mixture of Potassium Carbonate and Caustic Lime. After saturation with Chlorine the mixture is diluted with Water and then evaporated until crystals begin to form.

Properties: Colorless monoclinic prisms or plates, possessing a pearly lustre, neutral to test paper, odorless, and with a cooling, saline taste. Soluble in 16.5 parts of water at 15°, and but very sparingly soluble in alcohol at any temperature. When heated the salt first fuses, then gives off its oxygen, leaving a residue of potassium chloride.

Uses: As a source of Oxygen; in the manufacture of Potassium Permanganate, and in medicine chiefly as a remedy for ulcers in the mouth and throat.

Off. Prep.—Trochisci Potassii Chloratis; and an unofficinal solution containing 30 grains of the salt in a fluid ounce, for facilitating dispensing.

Caution: Potassium chlorate explodes violently when triturated with readily oxidizable substances, such as sulphur, which should therefore never be undertaken.

Potassium Citrate.—$K_3C_6H_5O_7 + H_2O$.—Potassii Citras, U. S.—Obtained by neutralization of a solution of Citric Acid with Potassium Bicarbonate, and evaporating the solution until a granular salt remains.

Properties: White, deliquescent powder, with cooling, faintly alkaline taste and neutral or slightly alkaline reaction. Soluble in 0.6 parts of water at 15°, loses its water of crystallization at 200° C, and chars.

Uses: As an arterial sedative and a diaphoretic.

Off. Prep.—Liquor Potassii Citratis and Mistura Potassii Citratis, the first mentioned being a solution of Citric Acid containing 30 grains to the ounce, saturated with Potassium Bicarbonate; the Mixture is Lemon-juice neutralized with Potassium Bicarbonate.

Potassium Cyanide.—KCN.—Potassii Cyanidum, U. S.—Obtained by fusing together proper proportions of dried Potassium Ferrocyanide and Potassium Carbonate.

Properties: Amorphous, or finely crystalline, white masses, deliquescent in moist air, with a penetrating odor resembling that of bitter almonds, and a sharp alkaline taste and reaction. Its fumes are poisonous when inhaled, and when taken internally the salt acts as a violent poison. It must be preserved in glass-stoppered bottles.

Uses: Its medicinal properties and uses are similar to those of hydrocyanic acid, for which it is sometimes used (in the right proportion) because of being more stable. The commercial article is largely used in the arts for plating, etc., but is usually too impure for medicinal purposes.

Potassium and Sodium Tartrate.—$KNaC_4H_4O_6 + 4H_2O$.—Potassii et Sodii Tartras, U. S.—This is commonly called Rochelle Salt, and is prepared by saturating a solution of Sodium Carbonate with Potassium Bitartrate, evaporating the solution and crystallizing.

Properties: In the form of a white powder, or in transparent rhombic crystals, slightly efflorescent in dry air, odorless, and with a bitterish mildly saline taste. Soluble in 2.5 parts of water at 15° C, and nearly insoluble in alcohol. Melts in its water of crystallization at about 75° C, at a more elevated temperature it dries and then chars.

Uses: In medicine as a laxative.

Off. Prep.—Pulvis Effervescens compositus.

Potassium Compounds—(Continued).

Potassium Ferrocyanide.—$K_4Fe(CN)_6+3H_2O$.—Potassii Ferrocyanidum, U. S.—From this, in the long run, nearly all the Cyanogen compounds are prepared. It is obtained by heating crude Potash in covered cast-iron pots, into which is thrown a mixture of Iron filings and Carbonaceous matters such as horn, feathers, dried blood, etc. The fused mass is lixiviated, and the clear liquid evaporated and crystallized.

Properties: Large, light-yellow, transluscent or nearly transparent, quadratic pyramidal crystals. Sp. gr. 1.83, permanent in dry air, heated to 60° begins to part with its water of crystallization, and at 100 it is completely given off, a white powder remaining. It is not poisonous.

Uses: Used in the preparation of Hydrocyanic Acid, the Cyanides, etc., and as a test for iron, zinc and copper.

Potassium Hypophosphite.—KH_2PO_2.—Potassii Hypophosphis, U. S.—Obtained by boiling a solution of Potassa with Phosphorus.

Properties: Either granular powder or white confused crystalline masses, neutral to test paper, odorless, with a sharp saline taste, very deliquescent, at 15° soluble in 0.6 parts of water, and in 7.3 parts of alcohol.

Uses: In the preparation of Syrup of Hypophosphites and various unofficinal preparations; Elixirs and Cod liver oil Emulsions.

Potassium Iodide.—KI.—Potassii Iodidum.—U. S.—Obtained by heating Iodine in a solution of Potassa, concentrating by evaporating and treating with Charcoal, drying and heating to redness, dissolving in Distilled Water, and crystallizing. The reactions that take place are represented as follows:

(1) $6KOH+3I_2=5KI+KIO_3+3H_2O$.

Potassium Iodate, KIO_3, is poisonous, and is heated with charcoal, when it becomes reduced to iodide:

(2) $2KIO_3+3C_2=2KI+6CO$.

Properties: Colorless, transparent or translucent, cubical crystals, somewhat deliquescent, with a faint, peculiar odor, a saline taste and neutral reaction. Soluble in 0.8 parts of water and 18 parts of alcohol at 15° C.

Uses: As a reagent in the laboratory, and in medicine as a resolvent, being the most valuable of all the compounds of iodine. It is usually administered in compound syrup of sarsaparilla, more especially to mask its disagreeable taste. It is also used to make iodine soluble in water or watery mixtures, as in the following officinal preparations:

Liquor Iodi Compositus: Iodine, 5 parts; Potassium Iodine, 10 parts; Water, 85 parts.

Unguentum Iodi: Iodine, 4 parts; Potassium Iodide, 1 part; Water, 2 parts; Benzoinated Lard, 93 parts.

Off. Prep.—Unguentum Potassii Iodidi: Potassium Iodide, 12 parts; Sodium Hyposulphite, 1 part; boiling Water, 6 parts; Benz. Lard, 81 parts.

Potassium Nitrate.—KNO_3—Potassii Nitras, U. S.—Commonly called Saltpetre. Usually obtained as a product of fermentation that takes place in soils, rich in certain forms of organic matter. It is common, particularly in certain hot countries, as India, Egypt, Persia, some portions of South America, etc., where it occurs as an efflorescence in the soil. This is collected and purified by repeated solution and re-crystallization.

Properties: Six-sided, usually striated, rhombic prisms, that are colorless, odorless, with a cooling saline taste, have sp. gr. of 2.1, and melts at 339° C. At a high temperature saltpetre evolves oxygen, and is gradually changed to the nitrite.

Uses: In medicine, as a diuretic, and in large doses as a cardiac and nervous sedative; in the arts for Gunpowder, and in domestic practice for curing meat.

Preparations.—Argenti Nitras Dilutus, Charta Potassii Nitratis, and for preparing the granular salt, which form alone should be used in medicine.

Potassium Permanganate.—$K_2Mn_2O_8$.—Potassii Permanganas, U. S.—Usually obtained by the reaction of Potassa and Potassium Chlorate on Manganese Dioxide.

Properties: Dark purple, or nearly black, rhombic prisms, with a metallic lustre, neutral to test paper; permanent in the air, odorless, sweetish and afterward disagreeable to the taste. Sp. gr. 2.7, soluble at 15° C, in 15 or 16 parts of water, forming a deep-purple colored solution.

Uses: Owing to the fact that it readily parts with oxygen in contact with organic matters, it is used as a Disinfectant, in the preparation of washes for foul ulcers, etc., and is also given internally in diphtheria, sore throat, etc. It should be exhibited only with substances free from organic matter, lest it be reduced, and for this reason, when prescribed in the pill form, the excipient should be petrolatum and kaoline or similar non-oxidizable substances.

Caution: It must not be mixed with glycerin or similar substances, which seize upon the oxygen with such avidity as to cause explosion.

Potassium Sulphate.—K_2SO_4.—Potassii Sulphas, U. S.—Occurs native in Sea-Water; in certain mineral waters, mixed with Common Salt, in some salt beds, and is obtained as a by-product in certain manufactures.

Properties: Crystallized in colorless, transparent, six-sided rhombic prisms. It does not change on exposure to the air, is without odor, with a cooling saline taste, and neutral to test paper. Its sp. gr. is 2.648, it is soluble in 4 parts of water at 15° C, much more freely soluble in boiling water, and nearly insoluble in alcohol.

Uses: In medicine, rarely, as a purgative. Owing to the hardness of the crystal, this salt was formerly used in the preparation of Dover's Powder for the purpose of facilitating comminution of the active ingredients; it was replaced by sugar of milk in the U. S. P. '80.

Potassium Sulphite.—$K_2SO_3+3H_2O$.—Potassii Sulphis, U. S.—Made by passing a current of Sulphurous Acid gas into a solution of Potassium Carbonate.

Properties: Crystallizes in oblique rhombic octahedra. Odor slight, taste bitter, saline and sulphurous, deliquescent, freely soluble in water, but slightly soluble in alcohol. On heating, decomposition takes place, water and sulphurous acid being given off.

Uses: In medicine as an anti-fermentative and anti-putrefactive.

Potassium Tartrate.—$(K_2C_4H_4O_6)_2+H_2O$.—Potassii Tartras, U. S.—Made by neutralizing a solution of Cream of Tartar with Potassium Carbonate.

Properties: Monoclinic, transparent, somewhat deliquescent crystals, with a saline, somewhat bitter taste, and neutral to test paper. When heated, water is given off, and at a higher temperature the mass becomes charred.

Uses: In medicine chiefly as an aperient, and in pharmacy as a test for glucose in Fehling's solution.

Sodium.

Sodium.

Sodium resembles potassium, and forms a similar series of compounds.

Sources.—Sodium does not occur native, but its compounds are abundant and widely distributed, common salt, Chili saltpetre, sodium carbonate and sodium sulphate forming considerable deposits in some localities. The silicates of sodium are also common minerals. Metallic sodium is obtained by a process analogous to that used for obtaining potassium, but it is obtained with less difficulty than the latter metal.

Properties: A white metal with a silvery luster, sp. gr. at 13.5° C, 0.9735 has the consistency of wax at ordinary temperature; when thrown on water melts by the heat produced by its union with the oxygen of the water, but the freed hydrogen of the latter is not inflamed unless the melted sodium globule be restrained from moving about, when it burns, and the flame has a deep yellow color. It rapidly oxidizes in contact with moist air.

Uses: The metal itself is not used in pharmacy, but its compounds are not less important than those of potassium.

Compounds of Sodium.

Soda.—NaHO.—Soda, U. S.—The process of manufacture is similar to that of potassa.

Properties: Caustic soda closely resembles caustic potassa in appearance and properties, and is usually cast in pencils in the same way. Soluble in 1.8 parts of water at 15° C., and freely soluble in alcohol. It does not produce a precipitate when an aqueous solution of it be dropped into an aqueous solution of tartaric acid, even when the latter remains in excess. It is thus readily distinguished from caustic potassa.

Uses: Similar to potassa.

Off. Prep.—Liquor Sodæ, made either from Sodium Carbonate and Lime, or by dissolving Caustic Soda in Water, similarly to the process for solution of potassa.

Sodium Acetate.—$NaC_2H_3O_2+3H_2O$.—Sodii Acetas, U. S.—Process of manufacture analogous to that of the corresponding salt of potassium.

Properties: Rather large, colorless, transparent, monoclinic prisms, which are odorless, slightly alkaline, have a bitterish saline taste and effloresce in dry air. At 75° C. the crystals melt, at 123° C. give off their water of crystallization, and at a higher temperature the mass blackens and decomposes.

Uses: Similar to those of Potassium Acetate, to which it is sometimes preferred because of its milder action.

Sodium Arseniate.—$Na_2HAsO_4+7H_2O$.—Sodii Arsenias, U. S.—Made by fusing together in the proper proportions Sodium Carbonate and Nitrate with Arsenious Acid, treating the fused mass with Water and crystallizing.

Properties: Colorless, transparent, prismatic crystals, that are odorless, and have a somewhat alkaline taste. Somewhat deliquescent, soluble in 4 parts of water at 15°. It is poisonous,

Uses: Similar to that of Fowler's Solution.

Off. Prep.—Liquor Sodii Arseniatis.

Sodium Benzoate.—$NaC_7H_5O_2+H_2O$.—Sodii Benzoas, U. S.—Made by neutralizing a solution of Benzoic Acid with Sodium Carbonate, the liquid evaporated and allowed to crystallize, or evaporated to dryness and the salt obtained as granulated.

Properties: White, semi-crystalline or amorphous powder, with usually a faint odor of benzoin, a sweet astringent taste, and neutral reaction. It effloresces on exposure to air, is soluble in 1.8 parts of water at 15° C., and at 450° C. it melts to a dark brown mass.

Uses: In gout, rheumatism and renal disorders.

Sodium Bicarbonate.—$NaHCO_3$.—Sodii Bicarbonas.—Made from the Carbonate by exposing it to Carbon Dioxide.

Properties: White powder, permanent in air, odorless, cooling, saline taste, and alkaline reaction. Soluble in 12 parts of water at 15° C., insoluble in alcohol. The aqueous solution if heated gives up a part of its carbon dioxide and becomes a solution of the carbonate.

Uses: For the preparation of various other sodium compounds, in medicine as an antacid, and in the manufacture of Baking-Powder.

Off. Prep.—Mistura Rhei et Sodæ; Pulv. Effervescence comp.; Trochisci Sodii Bicarbonatis.

Sodii Bicarbonas Venalis, U. S., is common, impure commercial sodium bicarbonate.

Sodium Bisulphite.—$NaHSO_3$.—Sodii Bisulphis, U. S.—Made by saturating a cold solution of Sodium Carbonate with Sulphurous Acid gas.

Properties: Either in a white granular powder or in opaque prismatic crystals, odor faintly sulphurous, taste disagreeable, undergoing decomposition on exposure to the air. Soluble in 4 parts of water at 15° C., much less soluble in alcohol.

Uses: Similar to that of the normal sulphite.

Sodium Borate. (See compounds of Boron).

Sodium Bromide.—NaBr.—Sodii Bromidum, U. S.—Prepared by a process similar to that employed for potassium bromide.

Properties: Either a white crystalline powder or small white monoclinic crystals, permanent in dry air, odorless, having a saline taste, and a neutral or faintly alkaline reaction. Soluble in 1.2 parts of water at 15° C., and in 13 parts of alcohol, and fusing without loss of weight at a dull red heat.

Uses: Same as those of Potassium Bromide.

Preparation.—An unofficinal Elixir containing 10 grains to the fluid dram. (See Nat. Form.)

Sodium Carbonate.—$Na_2CO_3+10H_2O$.—Sodii Carbonas, U. S.—Exists in many mineral waters, the waters of certain lakes in hot and dry countries, and also in plants. It is also prepared artificially in a variety of ways, from the mineral *Cryolite* by boiling it with an excess of Caustic Lime; from Sodium Sulphate by the self-same process, and in several other ways.

Properties: Large, colorless, oblique rhombic crystals, or in irregular lumps, with a strongly alkaline reaction, and with an alkaline taste. On exposure to the air it effloresces and falls to a white powder. Insoluble in alcohol, soluble in 1.6 parts of water at 15° C.

Uses: To prepare various other sodium compounds; only the whole crystals should be used. It is purified by re-crystallization, or granulated for medicinal use.

Off. Prep.—Sodii Carbonas Exsiccatus, made by exposing the crystals to the air, and then to a temperature of 45° C., until a white power is formed.

Sodium Compounds.

Sodium Chlorate.—$NaClO_3$.—Sodii Chloras, U. S.—Process of obtaining it analogous to that for obtaining the corresponding salt of potassium.

Properties: Transparent, tetrahedral crystals, permanent in the air, odorless, cooling, saline taste, and neutral reaction. Yields up its oxygen when heated, leaving common salt as the residue.

If triturated with organic or other easily oxidizable compounds, explosion is liable to occur.

Uses: Similar to that of Potassium Chlorate.

Sodium Chloride.—NaCl.—Sodii Chloridum, U. S.—This is common "salt," too familiar to require description. It is found native as Rock Salt in many parts of the world, and occurs in the sea, as well as in many lakes, and in plants and animals.

Uses: In pharmacy in the preparation of Chlorine gas, Hydrochloric Acid, Calomel, etc., and somewhat also in medicine, in washes and as a hæmostatic, etc.

Sodium Hypophosphite.—$NaH_2PO_2+H_2O$.—Sodii Hypophosphis, U. S.—Made by the neutral reaction of Sodium Carbonate and Calcium Hypophosphite, and in other ways.

Properties: Either a white powder, or colorless rectangular tabular crystals, deliquescent, odorless, with a saline, slightly sweetish taste, soluble in 1 part of water and 30 of alcohol at 15° C., and, when heated strongly, first loses its water of crystallization, and then undergoes decomposition.

Uses: In medicine, in treatment of phthisis, bronchitis, and in nervous debility.

Off. Prep.—Syrupus Hypophosphitum; Syrupus Hypophosphitum cum Ferro.; and in unofficinal Cod liver oil Emulsions, Elixirs, etc. (See Nat. Form.)

Sodium Hyposulphite.—$Na_2S_2O_3+5H_2O$.—Sodii Hyposulphis, U. S.—Usually prepared by heating together the proper proportions of Sulphur and dried Sodium Carbonate, stirring vigorously to facilitate oxidation, and then converting the normal Sulphite thus formed into the Hyposulphite by dissolving it in Water and boiling it with Sulphur. It is also prepared by decomposition of Calcium Thiosulphate with Sodium Carbonate, or Sulphate.

Properties: Monoclinic, prismatic or tabular crystals, permanent in the air, transparent, colorless, inodorous, and with a sulphurous, cooling and alkaline taste. Soluble in 1.5 parts of water and insoluble in alcohol at 15° C. On heating, it first loses its water of crystallization and then is decomposed with the separation of sulphur.

Uses: In medicine, for its anti-putrefactive and anti-fermentive properties, chiefly. In the arts, in the manufacture of paper and in photography as a solvent for bromide, or chloride, of silver.

Preparations: The Volumetric Test Solution and in the so-called Decolorized Tincture of Iodine:

Tincture Iodi Decolorata.—Prepared by digesting 610 grains each of Iodine and Sodium hyphosulphite in 1½ fl. oz. of water, until a dark, brownish-red solution results; adding 2 fl. oz. alcohol and 1 fl. oz. stronger water of ammonia, shaking until the solution has become colorless, then adding enough alcohol to make 16 fl. oz., and, after standing 3 days, rejecting the crystals which have separated. (Nat. Form).

Sodium Iodide.—NaI.—Sodii Iodidum, U. S.—Obtained by a process analogous to that used in the preparation of the corresponding salt of potassium.

Properties: Either a white powder or small, colorless or transparent, monoclinic crystals. Deliquescent, inodorous, and having a bitterish saline taste. Soluble in .6 parts of water and 1.8 parts of alcohol at 15° C. Melts at a dull red heat, and at a higher temperature volatilizes with partial decomposition.

Uses: Same as that of Potassium Iodide.

Sodium Nitrate.—$NaNo_3$.—Sodii Nitras, U. S.—Occurs native in extensive beds in Chili and Peru, and the crude article is called Chili saltpetre.

Properties: Transparent, colorless, deliquescent, rhombohedral crystals. Neutral to test paper, inodorous, taste cooling, saline and bitterish. Soluble in 1.3 parts of water and nearly insoluble in alcohol at 15° C. Melts at 312° C., and at higher temperatures gives off oxygen, and is converted into the nitrite.

Uses: Principal source of Nitric Acid, also used in preparing Sodium Arsenite. In medicine, chiefly as a mild purgative.

Sodium Phosphate.—$Na_2HPO_4+12H_2O$.—Sodii Phosphas, U. S.—Prepared by a somewhat complicated process from Bone-ash, Sulphuric Acid and Sodium Carbonate.

Properties: Transparent, colorless, monoclinic, prisms of large size, effloresceent on exposure to the air, inodorous and with a cooling, saline or somewhat alkaline taste, and a slightly alkaline reaction. Soluble in 6 parts of water and insoluble in alcohol, at 15° C. Loses its water of crystallization at 100° C., and at 300° C. is converted into the pyrophosphate.

Uses: For the preparation of the Sodium Pyrophosphate, of Iron Phosphate, etc. In medicine, mainly for its mildly purgative effects.

Sodium Pyrophosphate.—$Na_4P_2O_7+10H_2O$.—Sodii Pyrophosphas, U. S.—Prepared from the phosphate. (See above).

Properties: Translucent, colorless, monoclinic prisms, permanent in the air, odor and taste like the phosphate, soluble in 12 parts of water at 15° C., and insoluble in alcohol.

Uses: Chiefly for the preparation of Iron Pyrophosphate.

Sodium Salicylate.—$2NaC_7H_5O_3+H_2O$.—Sodii Salicylas, U. S.—Prepared by the reaction of Salicylic Acid on Soda, or on Sodium Carbonate, in Water.

Properties: White, tabular crystals of small size, or in the form of a white crystalline powder. Inodorous, saline, and somewhat sweetish taste, and slightly acid reaction. Dissolves in 1.5 parts of water and in 6 parts of alcohol at 15° C. Decomposed by heat, giving off inflammable vapors and leaving a charred mass.

Uses: In medicine, mainly in the treatment of rheumatism. Usually prepared extemporaneously in solution from salicylic acid and sodium bicarbonate.

Sodium Santoninate.—$2NaC_{15}H_{19}O_4+7H_2O$.—Sodii Santoninas, U. S.—Made by the reaction of Soda on Santonin, in the presence of Water, and crystallizing the salt.

Properties: Delicate white needles, or small white prisms, or transparent rhombic tables, slightly efflorescent and slowly colored yellow on exposure to the air, inodorous, saline and bitterish to the taste, and slightly alkaline in their reaction. At 15° C., soluble in 3 parts of water and 12 parts of alcohol. Parts with its water of crystallization at 100° C., and at a red heat decomposes.

Uses: Same as santonin, as an anthelmintic.

Off. Prep.—Trochisci Sodii Santoninatis.

Lithium.—Magnesium.

SODIUM COMPOUNDS.—(CONTINUED).

Sodium Sulphate.—$Na_2SO_4+10H_2O$.—Sodi Sulphas, U. S.—Commonly called Glauber's Salt. Frequently found native, and obtained as a by-product in many chemical processes.

Properties: Large, transparent, colorless, monoclinic prisms, which are odorless, with a cooling, saline, and a decidedly bitter taste. They effloresce and crumble to a white powder on exposure to dry air, are neutral to test paper, soluble in 2.8 parts of water at 15° C., and insoluble in alcohol.

Uses: As a purgative; chiefly in veterinary practice.

Sodium Sulphite.—$Na_2SO_3+10H_2O$.—Sodi Sulphis, U. S.—Prepared by neutralizing a solution of Sodium Carbonate with Sulphurous Acid gas.

Properties: Transparent, colorless, monoclinic prisms, odorless, with cooling, saline and somewhat sulphurous taste, and slightly alkaline reaction. Effloresces and gradually changes to the sulphate on exposure to the air. Soluble in 4 parts of water at 15° C., and but slightly soluble in alcohol. When heated it first melts, then loses its water of crystallization, and finally is decomposed, giving off sulphurous gas.

Uses: In medicine similar to those of potassium sulphite; mostly in the granulated form.

Sodium Sulphocarbolate.—$NaC_6H_5SO_4+2H_2O$.—Sodii Sulphocarbolas, U. S.—Obtained by the reaction of Barium Sulphocarbolate in solution, upon Sodium Carbonate or Sodium Sulphate.

Properties: Rhombic prismatic crystals, which are colorless or slightly pinkish, transparent, permanent in the air, inodorous, with a bitterish, saline taste. Dissolves in 5 parts of water and in 132 parts of alcohol at 15° C. When heated it first loses its water of crystallization, then decomposes, giving off the odor of carbolic acid, leaving behind a charred mass.

Uses: It has much the same medicinal value as carbolic acid, but is much milder in its action.

Sodium Molybdate.—$Na_2MoO_4+H_2O$, is of value in pharmaceutical chemistry as a test.

LITHIUM.

Lithium does not exist free in nature, and its compounds are much less abundant than either those of potassium or sodium. It occurs in certain minerals, as lepidolite, spodumene, petalite, etc.; in certain mineral waters, in minute quantities in sea-water, and even in most fresh waters. It occurs also in many plants.

The metal, which is too expensive to be more than a scientific curiosity, is obtained by electrolysis from the chloride. It bears a close resemblance to potassium and sodium in its properties. It is the lightest of all known metals, having a sp. gr. of only 0.5891.

The compounds of lithium of sufficient importance to require notice here, are the following:

Lithium Benzoate.—$LiC_7H_5O_2$.—Lithii Benzoas, U. S.—Made from the Carbonate by decomposing it with Benzoic Acid; it has been prepared and used to some extent in medicine as a substitute for sodium benzoate.

Lithium Bromide.—LiBr.—Lithii Bromidum, U. S.—Is made from the Carbonate by decomposing it with Hydrobromic Acid.

It has the same medicinal virtues as the other bromides, only, it is claimed, in a higher degree, because more soluble and containing a larger proportion of bromine.

Lithium Carbonate.—Li_2CO_3.—Lithii Carbonas, U. S.—Obtained from the Chloride by treating its solution with Ammonium Carbonate.

It is used in medicine as a solvent for uric acid deposits and gouty concretions; also as a remedy for gouty and rheumatic affections.

Lithium Citrate.—$Li_3C_6H_5O_7$.—Lithii Citras, U. S.—Made from the Carbonate by saturating a solution of it with Citric Acid.

Its virtues are similar to those of the carbonate.

Lithium Salicylate.—Lithii Salicylas, U. S.—Produced by the action of Salicylic Acid upon the Carbonate.

Its uses are similar to those of the corresponding salts of potassium and sodium.

MAGNESIUM.

Although an abundant metal, magnesium is not found free in nature. It occurs in the minerals, magnesite, dolomite, kieserite, spinelle, asbestos, serpentine, tourmaline, and many others; it occurs as the sulphate in many saline springs, notably those at Epsom, England; as chloride in sea-water, and in many salt springs, and it is also found in the bones of animals, and the tissues of many plants.

Sources: Magnesium is obtained from its Chloride, or the double Chloride of Magnesium and Potassium, by heating it, together with fluor spar and sodium, in a red hot iron crucible, and afterward distilling, avoiding contact with the air, when the crude metal is obtained.

Properties: Brilliant silver-white metal, soon tarnishing in damp air, sp. gr. 1.75. Melts at a red heat, and may be inflamed, when in the form of rather fine wire or ribbon, by holding it in a candle, when it burns with an intensely active flame, producing a bulky white oxide.

The metal itself is not of pharmaceutical importance, but several of its compounds have important uses.

Magnesia.—MgO.—Magnesia, U. S.—May be obtained by burning the Metal (see above), but much less expensively by igniting the Carbonate.

Properties: A very white and light powder, which on exposure to the air slowly absorbs carbon-dioxide and becomes converted into the carbonate. It should therefore be kept in tightly-stoppered bottles.

Uses: In medicine chiefly as a corrective to acidity in the alimentary tract.

Off. Prep.—Ferri Oxidum Hydratum cum Magnesia; Pulvis Rhei compositus; Trochisci Magnesiæ.

Heavy Magnesia.—Magnesia Ponderosa, U. S., is similar to the above, except in possessing only one-fourth the bulk, which facilitates its administration. It is prepared from the heavy carbonate.

Magnesium Carbonate.—$(MgCO_3)_4+Mg(HO)_2+5H_2O$.—Magnesii Carbonas, U. S.—It will be seen from the formula that the officinal carbonate is really a mixture of the Carbonate and Hydroxide. It is made by the reaction in solution of Sodium Carbonate and Magnesium Sulphate.

Properties: A very light white powder or friable masses, nearly insoluble in both alcohol and water. Dissolves with effervescence in hydrochloric acid.

Magnesium.—Calcium.

MAGNESIUM CARBONATE—(CONTINUED).

Uses: For the preparation of Magnesia, Liquor Magnesiæ Citratis and other compounds, and in medicine for similar purposes as magnesia; also as a Face Powder.

Off. Prep.—Mistura Magnesiæ et Asafœtidæ; Magnesii Citras Granulatus; Liquor Magnesiæ Cit.

Magnesium Sulphate.—$MgSO_4+7H_2O$.—Magnesii Sulphas, U. S.—Commonly known as Epsom Salt. It occurs native, as has already been stated, and is also manufactured from the mineral kieserite, which, aside from its impurities, differs in composition from Epsom salt only in having six molecules less of water of crystallization.

Properties: Four-sided rhombic prisms or acicular needles, or else in the form of powder; without odor, taste saline and bitter, freely soluble in water, and insoluble in absolute alcohol.

Uses: In the preparation of the Carbonate, and in medicine as a purgative.

Off. Prep.—Infusum Sennæ compositum.

Magnesium Sulphite.—$MgSO_3+6H_2O$.—Magnesii Sulphis, U. S.—Made by the reaction of Sulphurous Acid on Magnesia or Magnesium Carbonate.

Properties: White, crystalline, colorless and bitterish powder, with a sulphurous taste; changes to the sulphate gradually on exposure to the air, and hence should be kept in tightly-stoppered bottles.

Uses: Similar to those of sodium sulphite.

Calcium.

Calcium is an abundant metal in nature, being represented by a large number of compounds, several of which, like Limestone or native calcium carbonate, constitute no inconsiderable portion of the earth's crust, but the metal itself, although it has been isolated and studied, is rarely seen outside the chemical laboratory.

It is obtained by electrolysis, and is a yellow metal harder than lead, malleable, tough, or in some conditions brittle; undergoes oxidation slowly in dry air, rapidly in damp air, and when thrown into water decomposes it with rapid evolution of hydrogen.

Lime.—CaO.—Calx, U. S.—Made by calcining Limestone, when carbon dioxide and water are expelled, and Lime or Calcium Oxide remains.

Properties: Grayish white masses, which upon exposure to air gradually attract moisture and carbonic acid gas, and fall into a white powder. When moistened with water the latter is absorbed with the liberation of heat, the lime being hydrated, commonly termed "slacked." It is soluble in 750 parts of cold water, in much less, 1,300 parts, boiling water. Lime or burnt lime must be protected from moisture and air, and slaked lime should be prepared when wanted.

Uses: For dehydrating various substances, such as alcohol and ether; in the preparation of alkalies and alkaloids (see assay of opium), and certain organic acids. In preparing Chlorinated lime, potassium chlorate, etc.

Off. Prep.—Liquor Calcis, a saturated solution of Lime in Distilled water; Potassa cum Calce, Linimentum Calcis and Syrupus Calcis.

Sulphurated Lime.—Calx Sulphurata, U. S.—Commonly misnamed "Calcium Sulphide," is a mixture of sulphide and sulphate of calcium, prepared by fusing together Lime and Precipitated Sulphur.

Uses: As a depilatory, and internally in skin diseases.

CALCIUM COMPOUNDS.

Calcium Bromide.—$CaBr_2$.—Calcii Bromidum, U.S.—Made by dissolving Calcium Carbonate in Hydrobromic Acid.

Properties: Whitish salt in granules or powder, without odor, and a saline, bitter taste. It deliquesces in the air, is soluble in 0.7 parts of water and 1 part of alcohol, at 15° C., melts at a red heat, and at that temperature begins to give off bromine.

Uses: Similar to those of the other bromides.

Precipitated Calcium Carbonate.—$CaCO_3$.—Calcii Carbonas Præcipitatus, U. S.—It is the result of the double decomposition of Calcium Chloride and Sodium Carbonate.

Properties: Impalpable white powder, without odor or taste, having a neutral reaction, sp. gr. 2.72, and gives off carbon dioxide, and is converted into calcium oxide at a red heat.

Uses: As an astringent and antacid in medicine, and largely as an ingredient in Face Powder and Dentifrices.

Prepared Chalk.—$CaCO_3$—Creta Preparata, U. S.—Native Calcium Carbonate freed from most of its impurities by a peculiar process of trituration with water, termed *elutriation.*

Properties: White, amorphous powder, usually appearing in commerce in the form of small cones or drops.

Uses: Medicinally in many compounds, also largely in Face Powders and Dentifrices.

Off. Prep.—Hydrargyrum cum Cretæ, Mistura Cretæ; Pulvis Cretæ Aromaticus, and Trochisci Cretæ.

Calcium Chloride.—$CaCl_2$.—Calcii Chloridum, U. S.—Obtained by the reaction of Hydrochloric Acid on Marble, or other Calcium Carbonates.

Properties: Hard, white masses, which have a pungent, saline and bitter taste. It is a very deliquescent salt.

Uses: As a valuable test reagent in the pharmaceutical laboratory, for drying certain gases and liquids, and in the preparation of certain Calcium compounds. In medicine also as a resolvent.

Calcium Hypophosphite.—$CaH_4(PO_2)_2$.—Calcii Hypophosphis, U. S.—Obtained by heating Phosphorus with Milk of Lime.

Properties: Thin, colorless, transparent and flexible scales, or in white, pearly, lustrous, crystalline powder. Neutral, or slightly alkaline, odorless, and of a disagreeably bitter taste.

Uses: In the preparation of Syrup of Hypophosphites and various unofficinal Syrups, Elixirs and Emulsions used in the treatment of pulmonary diseases, etc. (Nat. Form).

Off. Prep.—Syrupus Hypophosphitum.

Precipitated Calcium Phosphate.—$Ca_3(PO_4)_2$.—Calcii Phosphas Praecipitatus, U. S.—Obtained by treating a dilute solution of Bone-Ash in Hydrochloric Acid with Ammonia. The precipitate is in the form of a light white powder, which at a red heat fuses, and on cooling forms a hard, porcelain-like mass.

Uses: For preparing syrup of phosphate of lime, and in medicine has the same uses as the hypophosphite; also as a medium in preparing Medicated Waters and Elixirs.

Off. Prep.—Pulvis Antimonialis, and Syrupus Calcii Lactophosphatis.

Albuminium.—Zinc.

Aluminium.

This metal does not exist free in nature, although, with the exception of oxygen and silicon, it is the most abundant and widely distributed of the elements.

It occurs as the oxide in Corundum, of which emery, ruby and sapphire are varieties; in the minerals, cryolite, bauxite and diaspor; in the different kinds of Feldspars, which make up a considerable portion of the weight of granite, syenite, gneiss, mica, porphyry, and so on; in the clays, which are essentially silicates of aluminium. The metal is, therefore, contained in abundance in all fertile soils.

Until very recently, the methods of extracting the metal from its ores have been cumbersome and expensive, and consequently its valuable properties have been but to a small extent utilized in the arts. Very recently, however, a process has been invented, which promises to greatly cheapen its production. This consists essentially in reducing the metal by the aid of carbon, and the very intense heat produced by an electric furnace.

Properties: A tin-white, very sonorous metal, capable of receiving a high polish, very malleable, ductile, and tough, sp. gr. from 2.56 to 2.67, conducts electricity eight times better than iron, does not oxidize at ordinary temperatures in the air, and produces, with copper and other metals, a series of alloys, some of which have exceedingly valuable properties. Except as a test, the metal is not used in pharmacy.

Compounds of Aluminium.

Alum.—$K_2Al_2(SO_4)_4+24H_2O$.—Alumen, U. S.—It is the double Sulphate of Aluminium and Potassium.

Obtained by digesting calcined Clay with Sulphuric Acid, and afterward adding, to the solution of aluminium sulphate thus obtained, the proper proportion of Potassium Sulphate, and crystallizing.

Ammonia alum is produced by adding Ammonium Sulphate instead of potassium sulphate.

Properties: Transparent, colorless, inodorous crystals of large size, which are octahedra, or octahedra combined with cubes, having a very astringent and somewhat acid taste, and an acid reaction. Effloresces somewhat on exposure to air, dissolves in 10.5 parts of water at 15° C., but is insoluble in alcohol; fuses at 92° C. in its water of crystallization, and again solidifies at a higher temperature, when the water has evaporated, the porous mass forming "burnt alum," Alumen Exsiccatum, U. S.

Uses: In pharmacy, for the preparation of other compounds of aluminium, and as a precipitant. In medicine, on account of its acid and astringent properties, and in the powdered form as an emetic.

Off. Prep.—Alumen Exsiccatum.

Aluminium Hydrate.—$Al_2(HO)_6$.—Aluminii Hydras, U. S.—Occasionally found native, but usually prepared from Alum by precipitating it with Sodium Carbonate in hot solution.

Properties: Amorphous white, odorless and tasteless powder, insoluble in water or alcohol. At a red heat loses water, and is converted into the oxide.

Uses: In medicine, as an antacid, and as a protective to the mucous membranes; and, in pharmacy, for preparing the Sulphate.

Aluminium Sulphate.—$Al_2(SO_4)_3+18H_2O$.—Aluminii Sulphas, U. S.—For medicinal use, prepared from Aluminium Hydrate by treating it with dilute Sulphuric Acid.

Properties: Sometimes in thin pearly lamellæ, but usually in a white, crystalline powder, inodorous, taste sweetish and astringent, and acid to test paper. It is permanent in the air, soluble at 15° C. in 1.2 parts of water, and nearly insoluble in alcohol, loses its water of crystallization at about 200° C., and at a red heat is decomposed, being converted into oxide.

Uses: In medicine, largely as a caustic in the treatment of chronically inflamed surfaces, exuberant growths, etc.

Zinc.

Zinc is a rather abundant metal, though rarely occurring uncombined in nature. Its most important ores are Calamine, or impure carbonate, zinc blende, franklinite and hydrozincite, and they are often found associated with lead ores.

The ores are first roasted to expel sulphur and other impurities, and the oxide thus obtained is heated with charcoal in a suitable furnace. The zinc is distilled over and condensed.

Properties: A bluish-white metal, which melts at 433° C., boils at 1040° C., is brittle at ordinary temperatures, but between 100° C. and 150° is quite malleable and ductile. Its sp. gr. is 6.9. When strongly heated in the air, it burns with a bluish flame, and is converted into the oxide.

Zincum, U. S., is used in pharmaceutical operations in the production of hydrogen gas. It should be free from arsenic. (See U. S. P.)

Compounds of Zinc.

Zinc Acetate.—$Zn(C_2H_3O_2)_2+3H_2O$.—Zinci Acetas, U. S.—Obtained by the reaction of Acetic Acid on Zinc Oxide, or Carbonate.

Properties: Thin, white, pearly, six-sided tables or scales, having a faint acetous odor, sharp, metallic taste, and slightly acid reaction. Soluble in 3 parts water and 30 parts alcohol, at 15° C.

Uses: Valuable as an irritant and astringent. Seldom used internally.

Zinc Bromide.—$ZnBr_2$—Zinci Bromidum, U. S.—Conveniently prepared by treating granulated Zinc with Hydrobromic Acid.

Properties: White, granular, very deliquescent powder, with a sharp saline and metallic taste. Melts on heating, boils at 700° C., and produces a sublimate of white needles. Rarely used in pharmacy or in medicine.

Precipitated Zinc Carbonate.—$(ZnCo_3)_2 3Zn(HO)(HO)_2$.—Zinci Carbonas Præcipitatus, U. S.—Made by pouring together solutions of Zinc Sulphate and Sodium Carbonate, in the proper proportions.

Properties: Soft and very fine white white powder, which is inodorous, tasteless, permanent in the air, and insoluble in water or alcohol, but soluble in the mineral acids with the evolution of carbon dioxide.

Uses: Externally as an astringent and protective to inflamed surfaces.

Preparations.—Unguentum Zinci Carbonatis, an ointment formerly officinal.

Zinc.—Manganese.

Zinc Chloride.—$ZnCl_2$.—Zinci Chloridum, U. S.—It is produced when pure Zinc is acted upon by pure dilute Hydrochloric Acid.

Pure zinc being expensive, in practice ordinary granulated zinc is used, and the iron and other impurities removed by treating the solution with Nitric Acid, evaporating it and heating the dry residue to fusion, to expel the nitric acid, then allowing the mass to cool. The solution thus obtained is treated with Water agitated with Carbonate of Zinc, then filtered, and the filtrate evaporated in a porcelain dish, until a drop withdrawn on the end of a glass rod solidifies on cooling to an opaque white solid.

Liquor Zinci Chloridi, U. S., is prepared in the same way, except that the last filtrate is not evaporated, but is diluted with water until it has the sp. gr. 1.555, and contains about 50 per cent. of the dry chloride.

Uses: Valuable as a deodorizer and disinfectant, and in injections and washes. As it is very irritant, and in large doses poisonous, it must be used with great care.

Zinc Iodide.—ZnI_2.—Zinci Iodidum, U. S.—May be made either by the direct action of Iodine on Zinc in the presence of water, or by that of hydriodic acid on the oxide or carbonate.

Properties: White, granular, crystalline and very deliquescent powder, which is inodorous, with a caustic, metallic taste, and an acid reaction. When heated with strong sulphuric acid decomposition takes place, and iodine and sulphurous oxide are liberated.

Uses: Sometimes internally, but more commonly as an external application as a wash for scrofulous sores, etc.

Zinc Oxide.—ZnO.—Zinci Oxidum, U. S.—Made best by exposing the Carbonate for some time to a dull red heat, or until a portion of it no longer effervesces with acids.

Properties: Nearly white or slightly yellowish, soft inodorous, tasteless powder, which on heating acquires a lemon-yellow color.

Uses: Rarely internally, but largely as a Dusting Powder for raw and inflamed surfaces; also in the form of ointment.

Off. Prep.—Unguentum Zinci Oxidi, also made with petrolatum, which in this case is superior to benzoated lard as a vehicle.

Zinc Phosphide.—Zn_3P_2.—Zinci Phosphidum, U. S.—Obtained by fusing Zinc in a crucible, and adding the requisite amount of Phosphorus a little at a time.

Properties: Gray, crystalline, friable mass, emitting a slight odor of phosphorus, undergoes very slow change in the air, and at a high temperature absorbs oxygen from the air, and is converted into the phosphate.

Uses: In the pill-form in doses of $\frac{1}{3}$ grain for nervous disorders.

Zinc Sulphate.—$ZnSO_4+7H_2O$.—Zinci Sulphas, U. S.—Obtained by treating Zinc with Dilute Sulphuric Acid.

Properties: Large, transparent, rhombic prisms, or in small prisms or prismatic needles, inodorous, taste styptic nauseous, acid to test paper, quite freely soluble in water, insoluble in strong alcohol.

Uses: Externally for its stimulant and astringent properties, for the preparation of injections, washes, collyria, etc.; internally in nervous diseases, and as a prompt emetic in doses of 10 grains. Also in the preparation of dry Oleate of Zinc, by chemical decomposition, and many other compounds.

Zinc Valerianate.—$Zn(C_5H_9O_2)_2+H_2O$.—Zinci Valerianas, U. S.—Obtained by the double decomposition of Sodium Valerianate and Zinc Sulphate when solutions of the two are mixed.

Properties: Soft, white scales of a pearly luster, faint odor of valerian; sweet, and afterward styptic, metallic taste; soluble in 100 parts of water and 40 parts of alcohol at 15° C.; and when heated, first melts and afterward decomposes, leaving zinc oxide.

Uses: Chiefly in the pill-form, in doses of one grain, in nervous affections.

Manganese.

This element, belonging to the iron group of metals, although represented in a number of common ores, pyrolusite, brannite, hausmanite, psilomelane, manganite, and several others, is not nearly so abundant in nature as iron. It is not found in nature in the metallic form, but the metal is extracted from its ores with some difficulty.

One method of obtaining it is as follows: The black Oxide is mixed with a flux composed of powdered Fluorspar and Soda-lime Glass; 6 parts of this are then mixed with 1 of Lampblack and 11 of Black Oxide of Manganese, and the whole subjected to an intense heat in a plumbago crucible which has been lined with 3 parts of graphite and one of fire clay. The impure product thus obtained is made nearly pure by fusion with half its weight of Manganese Carbonate.

Properties: As thus obtained it is a grayish or reddish white metal, resembling cast-iron. Its sp. gr. is 8.; it is hard and brittle, and so readily does it oxidize that it can not be kept in the air, but must be preserved in fluids not containing oxygen.

The metal itself has no pharmaceutical uses.

Compounds of Manganese.

Manganese Dioxide.—MnO_2.—Mangani Oxidum Nigrum, U. S.—A native mineral, and should contain at least 66 per cent. of the pure Dioxide.

A heavy, dull black, inodorous, tasteless powder, which is insoluble in water and alcohol.

Used but little in medicine, but is used as a source of Oxygen; in the manufacture of Chlorine gas, etc.

Manganese Sulphate.—$MnSO_4+4H_2O$.—Mangani Sulphas, U. S.—Made by the reaction of Sulphuric Acid on the Dioxide.

Transparent, colorless or pale rose-colored crystals, belonging to the right rhombic system. Inodorous, taste bitterish and astringent, slightly efflorescent, soluble in 8 parts of water at 15° C., but insoluble in alcohol. Reaction slightly acid.

Cerium.—Cadmium.

The only compounds of these metals of pharmaceutical importance are:

Cerium Oxalate.—Cerii Oxalas, U. S.—Prepared from Cerium Chloride by precipitation with Oxalic Acid. The chloride is obtained by the treatment of the mineral gadolenite or cerite in which form the metal is usually found.

Properties: The salt is insoluble in both alcohol and water, but soluble in hydrochloric acid.

Uses: In the powdered form, or as an effervescing granular salt, in nervous affections.

Cadmium Bromide, though an unofficinal salt, is sometimes used in pharmacy. It is prepared by double decomposition of solutions of cadmium sulphate and potassium bromide.

Iron and its Compounds.

Iron.

This well-known metal exists native only in meteoric stones, but its oxides and carbonates are very abundant, as are also many other of its compounds. The Oxides, which constitute the principal source of the metal, are reduced by carbon at a high temperature, and on this principle depends chiefly the process of smelting and extracting iron from its ores.

The metal is too familiar a commodity to need particular description here. Iron and its compounds are valuable in medicine for their tonic effects, deepening the color of the red corpuscles, and, some authorities say, increasing their number.

The metal itself is official in two forms :

Iron.—Ferrum, U. S.—In the form of fine, bright, non-elastic wire. It is used in making many of the preparations of iron. The other is

Reduced Iron.—Ferrum Reductum, U. S.—Made by heating the Hydrated Peroxide to redness in an iron tube, and passing a stream of Hydrogen through it.

It is a fine, grayish-black powder, attracted by the magnet, is without odor or taste, insoluble in water or alcohol, and, when ignited in the air, is converted into ferric oxide.

Compounds of Iron.

Ferric Acetate.—This is obtained by precipitating Ferric Hydrate from solution of the Tersulphate by Ammonia, thoroughly washing the precipitate, and then treating it with glacial Acetic Acid.

Ferric acetate, being unstable, is not officinal, but only its solutions :

Liquor Ferri Acetatis, U. S.—This contains 33 per cent. of the acetate. It should be kept in well-stoppered bottles, away from the light.

Tinctura Ferri Acetatis, U. S.—Consists of the solution 50 parts, alcohol 30 parts, acetic ether 20 parts.

Ferric Chloride.—$Fe_2Cl_6+12H_2O$.—Ferri Chloridum, U. S.—Made by adding slowly a mixture in proper proportions of Ferrous Chloride and Hydrochloric Acid to Nitric Acid, afterward heating the mixture to expel nitrous fumes, and crystallizing. It is an orange yellow, very deliquescent salt, usually in irregular masses of a crystalline fracture, often with a faint odor of Hydrochloric Acid, a styptic taste, and an acid reaction.

Liquor Ferri Chloridi, U. S.—Is prepared in the same way. It contains of the anhydrous chloride 37.8 per cent. in solution of Water, with 5 per cent. Hydrochloric Acid.

Tinctura Ferri Chloridi, U. S.—Contains 35 parts of the solution and 65 parts alcohol.

Mistura Ferri et Ammonii Acetatis, U. S.—Is prepared from the tincture chloride of iron 2 parts, solution ammon. acet. 20 p., dil. acetic acid 3 p., elixir, syrup and water, of each, to make 100 parts.

Ferric Citrate.—$Fe_2(C_6H_5O_7)_2+6H_2O$.—Ferri Citras, U. S.—Made by evaporating the solution at a temperature not higher than 60° C. until reduced to the consistency of syrup, and then spreading it on glass plates to dry.

Properties : "Transparent, garnet-red scales, permanent in the air, odorless, having a very faint, ferruginous taste, and an acid reaction."

Liquor Ferri Citratis, U. S.—Is the aqueous solution of the above, and contains 35.5 parts of the anhydrous salt. It is made by precipitating Ferric Hydrate from the solution of Tersulphate of Iron by means of Ammonia Water, dissolving the precipitate, carefully washed, in the proper proportion of Citric Acid, and evaporating the solution, at a low temperature, to the required strength.

Ferri et Ammonii Citras, U. S., is made by mixing 3 parts of the above solution with 1 part of Water of Ammonia, evaporating at a temperature not above 60° C., until it has been reduced to a syrupy consistency, then spreading it on glass plates, and drying. It is in the form of deliquescent, garnet-red scales. They must be kept in the dark, or in closely-stoppered bottles.

From this salt the following are made :

Ferri et Strychninæ Citras, U. S.—Contains 1 per cent. of Strychnine and 98 per cent. of the Citrate of Iron and Ammonia, and is in the form of garnet-red deliquescent scales.

Liquor Ferri et Quininæ Citratis, U. S.—Contains 32.5 per cent. of Citrate of Iron and Ammonia, and 6 per cent. of Quinine, and is a dark greenish-yellow liquid, with a bitter and slightly ferruginous taste and an acid reaction.

Vinum Ferri Amarum, U. S.—Contains 8 per cent. of the Solution of Citrate of Iron and Quinine.

Vinum Ferri Citratis, U. S.—Contains 4 per cent. of Citrate of Iron and Ammonia.

Citrate of Iron and Quinine.—Ferri et Quininæ Citras, U. S.—Made by evaporating a solution containg 88 parts of Citrate of Iron and 12 parts of Quinine, at a temperature not exceeding 60° C., until it reaches the consistency of syrup, then spreading it on a glass plate and drying.

Properties : Transparent, yellowish-brown or reddish-brown scales, that are somewhat deliquescent, inodorous, and with a bitter, somewhat ferruginous taste. Must be kept in well-stoppered bottles in a dark place.

Ammonio-Ferric Alum.—$Fe_2(NH_4)_2(SO_4)_4+24H_2O$.—Ferri et Ammonii Sulphas, U. S.—Made by dissolving Ammonium Sulphate in a hot solution of Tersulphate of Iron and crystallizing.

Transparent octahedral crystals of an amethyst or violet color, efflorescent, inodorous, and of an astringent taste.

Used in medicine for its astringent properties.

Tartrate of Iron and Ammoninm.—$2(FeO)NH_4C_4H_4O_6+5H_2O$.—Ferri et Ammonii Tartras, U. S.—Made by dissolving Ferric Hydrate (obtained by precipitating tersulphate of iron in solution with ammonia water) in a solution of Acid Ammonium Tartrate, until the solution is saturated, then evaporating the solution at a temperature not higher than 60°, and, when it reaches the consistency of syrup, spreading it on glass plates to dry.

Properties : Yellowish-brown, or red, transparent scales, neutral to test paper, inodorous, sweetish and slightly ferruginous to the taste, and only slightly deliquescent. Soluble in water, but almost insoluble in alcohol and ether. Should be kept in well-stoppered bottles in a dark place.

Tartrate of Iron and Potassium.—Ferri et Potassii Tartras, U. S.

The process of manufacture is analogous to that of the preparation just described, and the salts also resemble each other in their properties and uses.

Iron—(Continued).—Tin.

Ferric Hypophosphite.—$Fe_2(H_2PO_2)_6$.—Ferri Hypophosphis, U. S.—Obtained by the double decomposition of Sodium Hypophosphite and Ferric Chloride in aqueous solution.

Grayish or whitish, inodorous, nearly tasteless powder, permanent in the air, but slightly soluble in water, and freely so in hydrochloric acid.

Uses: In the preparation of unofficinal Syrups of Hypophosphites.

Iodide of Iron.—FeI_2.—Ferri Iodidum.—Ferrous Iodide.—Made by the reaction of Iodine upon Iron in the presence of Water until the mixture has lost the smell of iodine and acquired a green color, when it contains ferrous iodide in solution.

Ferri Iodidum Saccharatum, U. S.—Is prepared by filtering the Solution of Ferrous Iodide into Milk Sugar and evaporating to dryness. It should contain 20 per cent. of the iodide.

Properties: A yellowish or grayish, very hygroscopic powder, with a sweetish and slightly ferruginous taste.

Syrupus Ferri Iodidi, U. S.—Prepared by filtering the Solution of Ferrous Iodide into hot Syrup in such proportion that it contains 10 per cent. of ferrous iodide.

Both of these preparations must be kept in small tightly-stoppered vials.

Ferrous Lactate.—$Fe(C_3H_5O_3)_2+2H_2O$.—Ferri Lactas, U. S.—Made by the direct action of Lactic Acid on Iron.

Properties: Greenish-white, crystalline crusts or grains, not deliquescent, inodorous, with a sweetish, ferruginous taste and a slightly acid reaction.

Uses: In the preparation of Syrupus Hypophosphitum cum Ferro, U. S., consisting of one part of the above Lactate with 99 parts of Syrup of Hypophosphites.

Ferrous Oxalate.—$FeC_2O_4+H_2O$.—Ferri Oxalas, U. S.—Obtained by treating a solution of Ferrous Sulphate with the proper proportion of Oxalic Acid.

Properties: A yellowish, crystalline precipitate, inodorous and nearly tasteless, permanent in the air, but slightly soluble in water, at 155° C. loses its water of crystallization, and at a higher temperature is decomposed, leaving ferric oxide.

Ferric Hydrate.—$Fe_2(HO)_6$.—Ferri Oxidum Hydratum, U. S.—Made by precipitating a solution of Ferric Sulphate (tersulphate of iron) with Ammonia and thoroughly washing the precipitate. This, in its freshly prepared state, is the best antidote to arsenical poisoning, and the materials for preparing it should always be kept on hand.

Off. Prep.—Emplastrum Ferri; Trochisci Ferri; Ferri Oxidum Hydratum cum Magnesia.

Ferric Phosphate.—Ferri Phosphas, U. S.—Obtained by treating Citrate of Iron in solution, with Sodium Phosphate in proper proportions, evaporating the solution at a temperature not exceeding 60° C., until it reaches a syrupy consistency, and drying it on glass plates.

Properties: Transparent, bright-green scales, not deliquescent, turning dark on exposure to light, inodorous, having a somewhat acid taste and reaction, freely soluble in water, and insoluble in alcohol.

Off. Prep.—Syrupus Ferri, Quininæ et Strychninæ Phosphatum, and a similar unofficinal Elixir, N. F.

Ferric Pyrophosphate.—Ferri Pyrophosphas, U. S.—Prepared in the same way as the last named salt, except that Sodium Pyrophosphate is used instead of the phosphate.

Resembles the phosphate very closely in its properties, but differs in producing a white precipitate instead of a yellow one with solution of silver nitrate.

Uses: Chiefly in Elixirs, in combination with Cinchona or its alkaloids.

Ferrous Sulphate.—$FeSO_4+7H_2O$.—Ferri Sulphas, U. S.—Made by the action of Sulphuric Acid on Iron.

Properties: Large, pale bluish-green, efflorescent crystals, in the form of monoclinic prisms, inodorous, with a styptic saline taste and reaction. Soluble in 1.8 parts of water at 15° C., insoluble in alcohol. Ordinary impure ferrous sulphate is commonly called "copperas."

Off. Prep.—When deprived of its water of crystallization by heat, it forms a grayish powder and constitutes the *Ferri Sulphas Exsiccatus,* U. S., which enters into Pilulæ Aloes et Ferri, U. S.

When precipitated from its aqueous solution by alcohol, it forms a pale bluish-green, granular powder—*Ferri Sulphas Præcipitatus,* U. S.

Ferrous Sulphide.—FeS.—Though not official, is important as being the usual source of Sulphureted Hydrogen. It is made by the direct union of Iron and Sulphur at a high temperature.

Ferric Valerianate.—Ferri Valerianas, U. S.—Made by adding to a cold solution of either Ferric Chloride or Ferric Sulphate, a cold solution of Sodium Valerianate so long as a precipitate is produced.

A brick-red, amorphous powder with a slight odor and taste of valerianic acid. It is decomposed by boiling water, leaving ferric hydrate.

Tin.

This metal is rarely found native. Its principal ore is cassiterite, or tinstone, SnO_2, but it also exists in the form of tin pyrites, which is a compound of copper, zinc, iron and tin with sulphur; in the form of silicate, and in small proportion in several complex minerals.

It is obtained from Tin-Stone by crushing and washing to separate lighter impurities, roasting to oxidize sulphides that may be present, washing a second time to get rid of lighter oxides that may be present; and then reduction of the purified tin oxide thus produced, in a suitable furnace with anthracite or Charcoal.

Properties: Brilliantly lustrous, white metal, melting at 235° C., volatilizing at a white heat, sp. gr. 7.293, exhibits a fibrous fracture, when bent produced a crackling sound, is somewhat harder than lead, malleable and ductile, but not very tenacious.

As tin is not readily oxidized in moist air, it is highly valuable for coating iron and copper surfaces, which is its principal use in the arts.

Uses: In medicine, metallic Tin in the form of tin filings, the Chloride and the Bisulphide have been used as remedies for tapeworm.

All the preparations of tin *are poisonous.*

Tin Chloride.—$SnCl_2, 2H_2O$.—Stannous Chloride.—Obtained by dissolving Tin in Hot Hydrochloric Acid, is used as a reagent, and largely in the arts and manufactures.

Lead.—Copper.

Lead.

Lead is sometimes, but not often, found free in nature, but its ores are rather abundant, the most important being the Sulphide (galena) and the Carbonate (cerussite).

There are a variety of ways of obtaining it, depending on the character and purity of the ores. From a pure form of galena it is obtained by roasting it in a reverberating furnace, when a part of the ore is reduced and a part converted into the sulphate, and then, by afterward raising the temperature, the sulphate is also decomposed. In inferior ores carbon is used in the process.

Properties: A soft metal, with a metallic lustre and a blue-gray color; very ductile and malleable, but not very tenacious; quite soft; sp. gr. 11.4; melts at 325° C., and volatilizes at a white heat. The metal itself is not of importance in pharmacy.

The soluble compounds of Lead are all *poisonous.*

Lead Acetate. — $Pb(C_2H_3O_2)_2+3H_2O$. — Plumbi Acetas, U. S., Sugar of Lead.—Obtained by treating the Oxide with Acetic Acid.

Properties: Colorless, transparent or translucent prisms or tables, efflorescent, and slowly converted into carbonate on exposure to the air, with a faintly acetous odor, and a sweet, astringent and metallic taste. The commercial salt should be purified by recrystallization for medicinal use.

Uses: As an astringent in washes and injections; internally in the pill form, and in chemistry as a precipitant of various organic principles.

Subacetate of Lead, Solution.—Liquor Plumbi Subacetatis, U. S.—Sometimes called Goulard's Extract. Made by boiling a Solution of Acetate of Lead in Distilled Water with Oxide of Lead (litharge) until no more oxide is dissolved, or it is converted into Subacetate. The water lost by evaporation is replaced constantly and Distilled Water added, so that the finished liquid shall have the sp. gr. 1.228 and contain 25 per cent. of the salt.

Properties: The subacetate of lead in this solution is not a definite compound, but a mixture of Oxyacetates. Upon exposure it absorbs carbonic acid from the atmosphere and is converted into insoluble carbonate. Distilled water is therefore directed to be used in the preparation of the dilute solution or "lead water," as well as in the concentrated solution. It should be preserved in small, tightly-stoppered bottles.

Uses: Only externally as an astringent and sedative and in the following officinal preparations:

Liquor Plumbi Subacetatis Dilutus, containing 3 parts of the above Solution in 100 parts of Distilled Water.

Linimentum Plumbi Subacetatis, made by mixing 40 parts of concentrated Solution of Lead Subacetate with 60 parts of Cotton-seed Oil.

Ceratum Plumbi Subacetatis, prepared by mixing 20 parts of the concentrated Solution of Lead Subacetate with 80 parts of Camphor Cerate.

Lead Carbonate. — $(PbCO_3)_2Pb(HO)_2$. — Plumbi Carbonas, U. S.—White Lead.—Obtained by the reaction of Carbonic Acid on the Acetate.

Properties: Heavy, white powder, odorless, tasteless, permanent in the air, and insoluble in water and alcohol. When heated strongly, it changes to yellow, losing carbon dioxide and being converted into the oxide.

Uses: Externally as a protective to irritated surfaces, but owing to its poisonous character it cannot safely be applied except to the unbroken skin. It is largely used in the arts, ground in oil, as Paints

Off. Prep.—Unguentum Plumbi Carbonatis; also in the preparation of Liquor Gutta Percha as a clarifying agent.

Lead Iodide.—PbI_2. — Plumbi Iodidum, U. S.—Obtained by mixing a solution of Lead Nitrate and Potassium Iodide.

Properties: The precipitate obtained is a bright yellow powder, inodorous, of a somewhat metallic taste, turns brick-red when heated, and if in contact with the air, gives off iodine and is converted into oxyiodide, which is citron-yellow in color.

Uses: Externally in ointment, chiefly.

Off. Prep.—Unguentum Plumbi Iodidi.

Lead Nitrate.—$Pb(NO_3)_2$.—Plumbi Nitras, U. S.—Made usually by treating Litharge, or the Carbonate with Dilute Nitric Acid.

Properties: Colorless, transparent or nearly opaque octahedra, sp. gr. 4.4, permanent in air, and soluble in 2 parts of water, and nearly insoluble in alcohol at 15° C.

Uses: In preparing the iodide, and to a limited extent in medicine as a discutient and as a deodorizing agent.

Lead Oxide.—PbO.—Plumbi Oxidum, U. S.—Litharge.—Can be made by heating Metallic Lead strongly in Air, but is chiefly obtained as an Ore product in the extraction of silver from its ore.

Properties: Heavy powder, varying in color from yellowish to reddish, permanent in air, odorless, tasteless, insoluble in water and alcohol, and by means of the blow-pipe and charcoal, readily reducible to metallic lead.

Uses: In pharmacy, for preparing Digitalin, Lead plaster and various Salts of lead.

Off. Prep.—Liquor Plumbi Subacetatis; Emplastrum Plumbi.

Copper.

This metal occurs in considerable abundance, both native and combined. Its most important ores are the Black Oxide or melaconite, the Red Oxide, malachite, azurite, chalcocite or copper glance, and chalcopyrite or copper pyrites.

The methods of extracting the copper differ, according to the nature of the ores.

Properties: A red metal with a bright, metallic lustre, very tough, malleable and ductile, has a sp. gr. of 8.94, is next to silver in its conductivity of heat and electricity, and fuses at a bright red heat. It forms two oxides: red oxide and black oxide of copper.

Uses: Most of its compounds are alleged to be poisonous, and have but a limited use in medicine.

Copper Acetate.—$Cu(C_2H_3O_2)_2+H_2O$.—Cupri Acetas, U. S.—Verdigris.—It is variously prepared, but may be obtained by mixing solutions of Lead Acetate and Copper Sulphate, when Lead Sulphate will be precipitated and Copper Acetate remain in solution.

Properties: Deep blue-green, rhombic prisms, opaque or translucent, efflorescent, odorless, taste disagreeable, metallic, and with an acid reaction.

Uses: Chiefly in Collyria, Lotions, and as an ingredient in Corn remedies.

Preparations: Tincture Copper Acetate, Rademacher, prepared by digesting 90 parts Copper Sulphate and 112.5 parts Lead Acetate with 510 parts water. The mixture is boiled, and when cold, 390 parts Alcohol added, frequently agitated for 4 days, then filtered.

Silver.—Mercury.

COPPER.—CONTINUED.

Copper Sulphate.—$CuSO_4+5H_2O$.—Cupri Sulphas, U. S.—Blue Vitriol.—Obtained by oxidizing the Sulphide or by the action of Dilute Sulphuric Acid on the Metal.

Properties: Large, deep-blue, translucent, triclinic crystals, which on exposure to the air effloresce. They have an acid reaction, are without odor, and have a disagreeable metallic taste. Soluble in 2.6 parts of water at 15° C., and insoluble in alcohol. Converted by a temperature a little above 230° C. into the anhydrous salt, and at a red heat are decomposed.

Uses: Chiefly in Collyria, Injections, Lotions, and occasionally as an emetic, or in smaller doses as a tonic and astringent.

Cuprum Ammoniatum.—Made by rubbing together in a mortar, until effervescence ceases, Sulphate of Copper 4 parts, Carbonate of Ammonium 3 parts, and drying the resulting mass on bibulous paper at a gentle heat. Used in the officinal Volumetric Test Solution and also for coloring show-liquids.

SILVER.

Silver occurs both free and in combination. Its most important ores are silver glance (AgS_2), ruby silver (Ag_3SbS_3), silver-copper glance $(AgCu)_2S$, and horn silver (AgCl). It is obtained from the ores by processes which differ considerably, according to the nature of the ores, their purity, etc.

Properties: A bright, white metal, susceptible of a high degree of polish, the best conductor of heat and electricity, tenacious, malleable and very ductile, fuses at 1040° C., and volatilizes at a white heat. Its specific gravity is about 10.5.

Uses: In pharmacy, in the preparation of silver compounds. Its surgical uses are also numerous, because not readily oxidized.

SILVER COMPOUNDS.

Silver Cyanide.—AgCN.—Argenti Cyanidum, U. S.—Made by conducting a stream of Hydrocyanic Acid, distilled from a mixture of Ferrocyanide of Potassium and Sulphuric Acid, into a solution of Nitrate of Silver, and washing and drying the precipitate.

Properties: White, amorphous powder, permanent in dry air, but slowly growing brown by exposure to the light. It is without odor and taste, and not soluble either in alcohol or water.

Off. Prep.—Acidum Hydrocyanicum Dilutum.

Silver Iodide.—AgI.—Argenti Iodidum, U. S.—Obtained by mixing a solution of Silver Nitrate with one of Potassium Iodide.

Properties: An amorphous light-yellow and heavy powder, that is inodorous, tasteless, and insoluble in the ordinary solvents.

Its medicinal use is limited.

Silver Nitrate.—$AgNO_3$.—Argenti Nitras, U. S.—Obtained by treating Silver with Dilute Nitric Acid. This is the most important salt of silver.

Properties: Colorless, transparent, tabular, rhombic crystals, odorless, very caustic and bitter taste, and of neutral reaction. Soluble in less than its own weight of water, sparingly soluble in cold alcohol (1—26), more freely in boiling alcohol (1—5), soluble in ether, but almost insoluble in stronger ether. The crystals and the aqueous solution are permanent and not affected by light, but when exposed to the air become rapidly dark in color, owing to decomposition induced by contact with organic matter.

Uses: In medicine chiefly as a local remedy either in Solution, as a Wash, or in substance moulded into Sticks (lunar caustic) for cauterization. Sometimes given internally in the pill-form, in doses of about ¼ grain; but the excipient must be of indifferent character to prevent reduction of the salt. It is used largely as a Hair Dye, and for Indelible Ink, owing to its property of leaving a permanent black stain upon organic matter. Stains upon the skin may be removed by a solution of cyanide of potassium. Taken internally in large doses it is poisonous, chloride of sodium being the proper antidote.

From nitrate of silver most of the other silver compounds are prepared, as well as the following officinal preparations:

Argenti Nitras Dilutus.—Prepared by fusing together equal parts of Nitrate of Silver and Nitrate of Potassium, and cast into cones or cylindrical sticks.

Argenti Nitras Fusus.—Made by fusing the Nitrate and adding a little Hydrochloric Acid to the melted mass, which is then cast into sticks. This is the familiar Lunar Caustic; it is less friable when made by this process, the 5 per cent. of chloride of silver it contains rendering it tough.

Silver Oxide.—Ag_2O.—Argenti Oxidum, U. S.—Obtained by pouring a solution of Silver Nitrate into either a solution of Lime or of Caustic Potash.

Properties: Inodorous, brownish or blackish powder, undergoing reduction or partial reduction on exposure to light; its uses are similar to that of the nitrate.

MERCURY.

This is the only metal that is liquid at ordinary temperatures. It is sometimes found free in nature in minute globules, but is usually obtained from its ores, the chief of which is Cinnabar, an impure Sulphide of Mercury. The metal is obtained by roasting the ores in a suitable furnace. The sulphur burns and the mercury volatilizes and is collected in a cooling chamber to which the vapors are conducted.

Mercury.—Hydrargyrum, U. S.—(Quicksilver).—A silvery, mobile liquid, having a sp. gr. of 13.59, solidifying at —39.44° C., and boiling at 357.2° C. It forms two series of salts, the *mercurous* and *mercuric*.

Mercury in all its forms is active, and in its more soluble forms, highly poisonous. It acts powerfully on the glandular system, and is useful in many cases, both of local and general inflammation. The metal itself, in the liquid form, is not often medicinally employed, but by triturating it for a long time with fats, chalk or sulphur, it is mechanically reduced to a fine state of division, and in this form possesses more active properties, and has important medicinal uses. The following officinal preparations contain mercury in the *metallic* form:

Blue Mass.—Massa Hydrargyri, U. S.—Contains one-third its weight of Mercury made into a mass with Licorice, Althea and Honey of Rose, with the addition of 3 per cent. of Glycerin to keep it soft.

Mercury with Chalk.—Hydrargyrum cum Cretæ, U. S.—Contains 38 per cent. of Mercury, triturated with Sugar of Milk and Prepared Chalk, until so finely divided that no globules of mercury are visible with a lens magnifying not less than 10 diameters.

Mercurial Ointment.—Unguentum Hydrargyri, U. S.—Containing one-half its weight of Mercury. The Mercury is best extinguished by the employment of a little Wool-Fat.

Mercurial Plaster.—Emplastrum Hydrargyri, U. S.—Containing 30 per cent. of Mercury, and

Ammoniac Plaster with Mercury.—Emplastrum Ammoniaci Hydrargyro, U. S.—Containing 18 per cent. of Mercury. (These have all been described in Lecture IV).

Mercury Compounds.

MERCURY COMPOUNDS.

Ammoniated Mercury.—NH_2HgCl.—Hydrargyrum Ammoniatum, U. S.—White Precipitate.—Obtained by decomposing a solution of Mercuric Chloride in Ammonia Water in excess, a white precipitate of mercur-ammonium chloride being formed. This, after being washed, is dried between sheets of filter paper at a gentle heat.

It is used only in the form of ointment.

Unguentum Hydrargyri Ammoniati, U. S., strength 10 parts to 90 of Benzoinated Lard.

Mercuric Chloride.—$HgCl_2$—Hydrargyri Chloridum Corrosivum, U. S.—*Corrosive Sublimate.*—Usually prepared by the double decomposition of Mercuric Sulphate and Sodium Chloride. In practice, salt, manganese dioxide and mercuric sulphate are heated together in a suitable retort, when the mercuric chloride is distilled off.

Properties: Heavy white crystalline masses, or colorless rhombic prisms. Sp. gr. 5.4, fuses at 265°, and sublimes without residue when the temperature is raised above this. Permanent in air, inodorous (but its dust very irritating), with an acrid metallic taste, soluble in 16 parts of water at 15°, and in 3 parts of alcohol at the same temperature. It is a powerful irritant poison. Antidote: White of egg or milk.

Uses: In making several other mercury preparations; in medicine, as an alterative and externally as an antiseptic. It is the most powerful of all known antiseptics, but owing to its poisonous properties it must be used only with great care. With potassium iodide it forms a double compound, a 10 per cent. solution of it being a valuable reagent for the alkaloids (*Mayer's Solution*). With Lime Water it forms a yellow mixture, Lotio Flava, "Yellow Wash," N. F.

Mercurous Chloride.—Hg_2Cl_2.—Hydrargyrum Chloridum Mite, U. S.—*Calomel.*

Obtained by the double decomposition of Mercurous Sulphate and Sodium Chloride. Practically, mercury and sulphur are mixed in such proportion as would form mercurous sulphate, and this is mixed with the requisite proportion of salt in a suitable retort and subjected to heat. The calomel is sublimed and collected in a cool chamber, when it is washed with water to free it from mercuric chloride and then dried.

Properties: A fine, white, heavy powder, consisting usually of minute, needle-shaped crystals, inodorous tasteless, insoluble in water and other simple solvents, permanent in air, but partially altered by light, sp. gr. varying somewhat, but about 7., colored black and changed in composition by ammonia water.

Caution.—When left in contact with the chlorides of ammonium, potassium and sodium, it undergoes a change into mercuric chloride, and great care should therefore be observed in dispensing calomel in conjunction with these substances.

Uses: In medicine, as a cathartic, and externally as a wash combined with lime water—Lotio Nigra, N. F.

Off. Prep.—Pilulæ Antimonii comp.; Pilulæ Catharticæ comp.

Mercuric Cyanide.—$Hg(CN)_2$.—Hydrargyri Cyanidum, U. S.—Obtained best by dissolving Mercuric Oxide in Hydrocyanic Acid. The hydrocyanic acid is prepared for the occasion by treating Potassium Ferrocyanide with Sulphuric Acid.

Properties: Colorless, or white quadrangular prisms, permanent in air, inodorous, bitter, metallic taste, if kept from the light, permanent in the air, and soluble at 15° C. in 12.8 parts of water and 15 parts of alcohol. It is very poisonous.

Uses: Similar to mercuric chloride, but a dangerous and little used remedy.

Mercuric Iodide.—HgI_2.—Hydrargyri Iodidum Rubrum, U. S.—Obtained by the reaction of Potassium Iodide and Mercuric Chloride in solution.

Properties: Scarlet red, crystalline powder, without color or taste, permanent in air, nearly insoluble in water and soluble in 130 parts of alcohol. A powerful irritant poison.

Uses: Occasionally given in syphilis, either alone in the pill-form, or in solution in conjunction with potassium iodide, but mainly used externally in treatment of skin diseases, glandular swellings, etc.

Off. Prep.—Liquor Arsenii et Hydrargyri Iodidi.

Mercurous Iodide.—Hg_2I_2.—Hydrargyri Iodidum Viride, U. S.—Obtained by the direct union of Mercury and Iodine.

Properties: Green, or yellowish green, which becomes lighter colored on exposure to the air, but is darkened when exposed to light, without odor or taste, insoluble in alcohol, and nearly so in water. It is less poisonous than the red iodide.

Uses: Chiefly in treatment of syphilis in the pill-form, in doses of $\frac{1}{8}$ to $\frac{1}{2}$ grain.

Yellow Mercuric Oxide.—HgO.—Hydrargyri Oxidum Flavum, U. S.—Obtained by mixing solutions of Mercuric Chloride and Potassa, and collecting, thoroughly washing and drying the precipitate.

Properties: Orange-yellow, heavy powder, permanent in the air, odorless, tasteless, insoluble in water and alcohol, and changing to red when strongly heated.

Off. Prep.—Oleatum Hydrargyri; Unguentum Hydrargyri Oxidi Flavi.

Red Mercuric Oxide.—HgO.—Hydrargyri Oxidum Rubrum, U. S.—Red Precipitate. Usually obtained by decomposing the Nitrate by means of heat.

Properties: Crystalline, red, or orange-red, heavy powder, or scales, permanent in air, odorless, tasteless, insoluble in water and alcohol. It turns darker when heated, and at a high temperature evolves oxygen and is reduced to the metallic state.

Off. Prep.—Unguentum Hydrargyri Oxidi Rubri.

Basic Mercuric Sulphate.—$Hg\ (HgO)_2SO_4$.—Hydrargyri Subsulphas Flavus, U. S.—Obtained by adding the Normal Sulphate, $HgSO_4$ (produced by treating metallic mercury with hot sulphuric acid) to boiling Distilled Water.

Properties: Heavy, bright lemon-yellow powder, unchangeable in the air, odorless, slight metallic taste, sp. gr. 6.44, very slightly soluble in cold water, insoluble in alcohol, and when heated turning red, but resuming its original color on cooling. It is a powerful irritant poison. But little used medicinally.

Mercury—(Continued).—Antimony.

Red Mercuric Sulphide.—HgS.—Hydrargyri Sulphidum Rubrum, U. S.—Commonly known as Cinnabar.—Occurs native, and in that form constitutes one of the principal ores of mercury. It is also made by heating together Mercury and Sulphur, in proper proportions, and finally subliming the mixture.

Properties: In the form of brilliant, dark-red masses having a crystalline structure, or else a bright-scarlet powder, inodorless, tasteless, permanent in the air, insoluble in water or alcohol, it turns dark on heating, but resumes its normal hue again on cooling. The pure sulphide is completely volatilized by heat, which is not true of samples adulterated with red lead, or with basic lead chromate. Seldom used medicinally.

Mercuric Nitrate.—$Hg(NO_3)_2$.—Hydrargyri Nitras.—Made by dissolving metallic Mercury in Nitric Acid. It is officinal in the following forms:

Liquor Hydrargyri Nitratis.—Containing 50 per cent. by weight of Mercuric Nitrate with some free Nitric Acid, sp. gr. of the solution 2.100.

Unguentum Hydrargyri Nitratis.—Citrine Ointment. Prepared by mixing a solution of Mercuric Nitrate with Lard Oil, previously acted upon by nitric acid in order to prevent the decomposition of the mercuric nitrate. (See Ointments, Lect. IV).

Antimony.

This metal rarely occurs in the native state. Its most common ore is stibnite, Sb_2S_3, but many others are known, as a compound of iron, antimony and sulphur; of copper, antimony and sulphur; and a compound of lead, antimony and sulphur, etc.

The metal is extracted from its Sulphide by a very simple process. The ore is first roasted, whereby the sulphide is converted into oxide. It is then heated with Carbon, which combines with the oxygen of the oxide and sets the metal free.

Properties: Lustrous, silver-white metal, of a crystalline structure, and at ordinary temperatures brittle; fuses at 425° C., volatilizes at a red heat, and at the temperature of its melting point readily oxidizes in the air, but remains unchanged at ordinary temperatures. Its sp. gr. is about 6.86.

Uses: The metal is of no direct use in medicine, but is used for preparing Tartar Emetic and other compounds of antimony.

Its soluble compounds are all *poisonous.*

Antimony and Potassium Tartrate.—$2(KSbOC_4H^4O_6)+H_2O$.—Antimonii et Potassii Tartras, U. S.—Made by the action of Acid Tartrate of Potassium on Oxide of Antimony, in the presence of Water.

Properties: Colorless, transparent crystals of small size, in the form of rhombic octahedra which, on exposure to the air, become white and opaque, are inodorous, have a sweetish, followed by a disagreeable, metallic taste. Soluble in 17 parts of water at 15° C., insoluble in alcohol. It is readily precipitated from its aqueous solution by alcohol, and in this case falls as a fine crystalline powder.

Uses: As a Test; in preparing several officinal compounds, and in medicine as an emetic and irritant. As an antidote, tannin should be given.

Off. Prep.—Syrupus Scillæ compositus; Vinum Antimonii.

Antimonius Oxide.—Sb_2O_3.—Antimonii Oxidum, U. S.—This oxide exists in nature as the mineral cervatite, but it is usually prepared for medicinal use from the Chloride, by pouring a strong solution of it into cold Water, which precipitates the Oxychloride, washing this thoroughly with distilled water, then treating it with the solution of an alkali or alkaline carbonate to remove the remaining chlorine, then again washing, and lastly, drying the precipitate.

Properties: A heavy, grayish-white powder, but slightly soluble in water, and insoluble in alcohol. Soluble in hydrochloric, but not in nitric acid. When heated in closed vessels it turns yellow, but it resumes its normal hue in cooling; at a dull red heat it fuses to a yellow liquid, but concretes, on cooling, to a white crystalline solid; and when heated to a bright red heat it sublimes and forms crystals. These needle-like or octahedral crystals, produced by sublimation, are called flowers of antimony.

Uses: In pharmacy to prepare Tartar Emetic, and occasionally in medicine as a nauseant, sudorific or emetic.

Off. Prep.—Pulvis Antimonialis.

Antimonious Sulphide.—Sb_2S_3.—Antimonii Sulphidum, U. S.—This occurs, as above stated, in nature as the mineral stibnite. It is freed from the impurities, with which the native mineral is usually associated, by fusion, the impurities mostly remaining behind, while the Sulphide is poured off.

Properties: In masses of a steel-gray color, more or less striated and of a metallic lustre, forming, when pulverized, a dull grayish powder, which is insoluble in alcohol or water, and without odor or taste. It may be distinguished from black oxide of manganese, which it outwardly resembles, by its ready fusibility.

Uses: It is seldom used in medicine at the present time, but it constitutes the chief source of the metal and of the various preparations of antimony.

Off. Prep.—Antimonii Sulphidum Purificatum.

The object of the process given in the Pharmacopœia is to get rid of arsenical impurities which are liable to be present, but the process is faulty since much of the antimonious sulphide is also dissolved by the ammonia. The process is improved by adding Ammonium Carbonate, after digesting in Ammonia Water, and agitating the mixture occasionally during a period of two or three days, and afterward thoroughly washing and drying the powder. Arsenic is readily soluble in ammonium carbonate, while antimonious sulphide is insoluble in it.

Sulphurated Antimony.—Antimonium Sulphuratum, U. S.—Consists chiefly of Antimonious Sulphide mixed with a small amount of Antimonious Oxide. Obtained by dissolving the purified sulphide in an aqueous solution of one of the Fixed Alkalies, and then precipitating it by means of Dilute Sulphuric Acid.

Properties: An amorphous, reddish-brown powder, inodorless, tasteless, and insoluble both in water and alcohol. When heated with twelve times its weight of officinal hydrochloric acid it is nearly all dissolved, with the evolution of sulphureted hydrogen.

Uses: It is not much used at present in medicine, but has the essential properties of other antimony compounds.

Off. Prep.—Pilulæ Antimonii compositæ.

Arsenic.—Bismuth.

Arsenic.

This element occurs in nature, both free and in combination. In the former state it is often seen in mammillated or kidney-shaped masses, but sometimes in crystals. In combination it is far more abundant. The most common of its ores are arsenical pyrites, Fe_2S_2As; tin-white cobalt, $(FeNiCo)As_2$; arsenical nickel; arsenical iron, $FeAs_2$; realgar, As_2S_2, and orpiment, As_2S_3.

The arsenic of commerce is either native, or derived from Arsenical pyrites by heating it in an earthenware tube in a furnace. The arsenic is volatilized and collected in a tube of sheet-iron, inclosed in the cooler end of the earthenware tube.

Properties: As an element it stands nearly midway between the metals and the non-metals, having properties which ally it with both. It has in the ordinary form a steel-gray color, and sometimes a metallic lustre, and its sp. gr. at 14° C. is 5.727, but two other forms are known, in both of which the sp. gr. is 4.710. When heated it does not melt, at least under ordinary atmospheric pressure, but passes directly into the vaporous condition. Its vapor is of a lemon-yellow color, and has the disagreeable odor of garlic. When heated in oxygen it is converted into arsenious acid.

Arsenic and all its compounds are poisonous, some of them exceedingly so; *hydrated oxide of iron*, the proper antidote, has been noticed elsewhere. Arsenic itself is not used in medicine, but several of its compounds are.

Compounds and preparations of arsenic.

Several of these, as Arsenious Acid, Sodium Arsenite, etc., have been described under other heads. It remains to mention here only the following:

Arsenic Iodide.—AsI_3.—Arsenii Iodidum, U. S.—Is obtained by fusing together, in equivalent proportions, Arsenic and Iodine.

Properties: It occurs either in crystalline, shining scales of an orange-red color, or in orange-red masses of a crystalline fracture. It has the color and taste of iodine, and undergoes slow decomposition on exposure to the air losing iodine. It is completely volatilized by heat, and it is soluble in 3.5 parts of water and 10 parts of alcohol at 15° C.

Uses: It is used in medicine for its alterative effects; in large doses, however, it acts as a violent irritant poison.

Off. Prep.—Liquor Arsenii et Hydrargyri Iodidi.

Arsenic Oxide.—As_2O_5.—A white salt, which, in moist air, deliquesces, forming arsenic acid, is used somewhat in the arts, but only rarely in medicine. Compounds of lesser importance in pharmacy are:

Arsenious Chloride, As_2Cl_3, a poisonous, oily-looking liquid.

Arsenious Bromide, As_2Br_3, a colorless, crystalline, poisonous salt.

Realgar, or Red Orpiment, As_2S_2, a mineral which exists in orage-red scales or crystalline masses, and

Orpiment, As_2S_3, a crystalline, yellow mineral occuring in prisms or scales.

Bismuth.

Bismuth exists in the metallic state in some localities. The commercial supply is chiefly derived from the mines in Saxony, where it occurs associated with silver, cobalt and nickel. It also exists as the oxide and sulphide, and in other combinations. It is readily separated from the metals, with which it is alloyed, by taking advantage of its comparatively low fusing-point.

Properties: Hard, brittle, bright, metallic luster, crystalline structure, grayish, with a reddish tinge, sp. gr. 9.823, melts at 270° C., and expands in solidifying. The metal itself is not used in medicine.

Compounds of bismuth.

Bismuth Citrate.—$Bi(C_6H_5O_7)$.—Bismuthi Citras, U. S.—Obtained by boiling the Sub-nitrate in a solution of Citric Acid.

Properties: White, amorphous powder, permanent in the air, odorless, tasteless, insoluble in water and alcohol, but soluble in water of ammonia.

Uses: Similar to sub-nitrate and sub-carbonate, and to prepare the citrate of bismuth and ammonia.

Bismuth and Ammonium Citrate.—Bismuthi et Ammonii Citras, U. S.—Made by dissolving Bismuth Citrate in weak Ammonia-Water, filtering and evaporating the liquid until it is of a syrupy consistence; it is then spread upon glass-plates and allowed to dry, when the salt is obtained in scales.

Properties: Pearly or nearly transparent scales, becoming opaque on exposure to the air, of neutral or faintly alkaline reaction, very soluble in water, but sparingly in alcohol. The salt loses ammonia if not carefully protected from the air, and becomes insoluble in water, but when the liquid is rendered slightly alkaline by addition of ammonia-water, it becomes again easily soluble.

Uses: In many Elixirs associated with iron, quinine, hydrastine, strychnine, pepsin, etc. With pepsin, which requires an acid solvent, the sodio-bismuth tartrate has been employed, instead of the ammonio-citrate of bismuth, the latter being precipitated in acidulated solutions.

Liquor Bismuthi contains two grains of the ammonio-citrate in one fluid drachm.

Bismuth Subcarbonate.—$(BiO)_2CO_3+H_2O$.—Bismuthi Subcarbonas, U. S.—Obtained by dissolving Metallic Bismuth in Nitric Acid, and pouring the solution into a solution of Ammonium Carbonate, collecting and thoroughly washing and drying the precipitate.

Properties: Whitish or slightly yellowish, amorphous powder, unchangeable in the air, inodorous, tasteless, insoluble in water and alcohol, and at a red heat, is converted into yellow bismuthous oxide.

Uses: Same as subnitrate, which see.

Bismuth Subnitrate.—$BiONO_3+H_2O$.—Bismuthi Subnitras, U. S.—Obtained by dissolving the metal in Nitric Acid, pouring the concentrated solution into Distilled Water, and collecting the precipitate. Should be freed from Arsenic, usually present in the metal.

Properties: Heavy, white powder, permanent in the air, odorless, tasteless, and insoluble in water and alcohol. At a red heat is also, like the subcarbonate, converted into yellow bismuthous oxide.

Uses: Internally, either alone or in conjunction with pepsin, in disorders of the stomach and alimentary canal, where, owing to its insolubility, it protects inflamed surfaces. Externally as Injection and Ointment, and popularly as a Snuff in catarrh.

Also for preparing Citrate of Bismuth, and several unofficinal compounds.

The following metals, of little importance in pharmacy, except as reagents, are treated in the Term in Chemistry: Barium, Cobalt, Nickel, Gold and Platinum.

Questions on Lecture IX---Series 7.

1. Describe the properties of Acids.
2. How do the Inorganic acids differ from the Organic acids in their *structure?*
3. How do the Inorganic acids differ from the Organic acids in their *basicity ?*
4. Define the difference between a Mono-basic and a Di-basic Acid.
5. What is peculiar of the solubility of Arsenic in water?
6. What is the best *antidote* for Arsenic?
7. What is the dose of Arsenic?
8. Why should Chromic Acid never be mixed with substances of *organic* nature?
9. What occurs when Alcohol and Chromic Acid are mixed?
10. What is "Spirit of Salt"?
11. What is "Oil of Vitriol"?
12. What is "Prussic Acid"? Give its strength and dose.
13. What Acid is obtained *directly* from Sulphur?
14. What purposes does Nitric Acid generally subserve in Manufacturing Pharmacy?
15. What other substances might be employed instead to answer these purposes?
16. What is the chemical designation of the Acid of Phosphorus officinal in the U. S. P. 1880?
17. What is Nitric Acid derived from?
18. How should the following be mixed: Sulphuric Acid and Distilled Water, equal parts by weight?
19. Describe the official process for Sulphurous Acid.
20. What are the Ammonium compounds chiefly derived from?
21. What is the strength of the officinal Aqua Ammonias?
22. How would you determine the *strength* of the above according to the U. S. P.?
23. Why is Ammonia Water used in the preparation of the purified Ammonium Chloride?
24. What is the constitution of "Tinctura Iodi Decolorata"?
25. What is the strength of officinal Chlorine Water?

IMPORTANT.

Students will please reply to the above questions on *letter-size* paper (not note), *in ink*, as briefly as possible and without copying the lecture. Write plainly on *one* side of the paper only (which must be signed, or no notice can be taken of it), and forward promptly to the Director. In answering it is *not* necessary to repeat the question itself, but only the *number* of each question.

☞Write a copy of your answers and preserve it for future use.

National Institute of Pharmacy.

LECTURES, SEMI-MONTHLY, BY MAIL.
C. S. HALLBERG, Ph. G., *Director*.

DEPARTMENT OF EXAMINATIONS.

CHICAGO, Nov. 1891.

L. F. Carpenter, East Hampton, Conn.

Upon Questions on Lecture X., Series 8, we transmit the following printed answers for further comparison and study:

1. KHO. Potassium Hydrate.

2. Owing to several conditions, chief of which are the comparative insolubility of calcium hydrate and the variability of moisture and impurities contained in the lime and alkali compounds.

3. Refer to page 104.

$K_2CO_3 + CO_2 + H_2O = 2\,KHCO_3$.

4. As a reagent, as an oxidizing agent, in dyeing, and in preparing "show-globe" color.

5. It melts to an oily liquid, then undergoing decomposition, Acetone being formed and vaporized and Carbonate remaining as the fixed residue.

6. Owing to its great deliquescence and liability to liberate acetic acid which is replaced by carbonic acid from the air.

7. Arsenite of Potassium in aqueous solution.

8. The Cyanide is a powerful poison while the Ferrocyanide is relatively quite innocuous.

9. Sodium compounds are efflorescent and impart a yellow color to non-luminous flame.

10. Solution of Potassium Citrate and Mixture of Potassium Citrate.

11. Pulvis Rhei compositus.

12. An Oxide of Calcium.

13. Refer to page 110.

14. Syrup of Hypophosphites and Syrup of Hypophosphites with Iron.

15. Nitrate of Sodium.

16. (a) $Al_2H_6O_6$.

(b) By double decomposition between Alum and Sodium Carbonate.

17. As a source of other Aluminium compounds.

18. One is prepared from the light carbonate, the other from the heavy carbonate.

19. Solution of Potassium Ferricyanide should not produce a blue coloration or precipitate.

20. Chemically, no difference; physically, it is one of form.

21. It is a 25 per cent aqueous solution of Lead Oxyacetates.

22. Avoid contact with organic matters and other substances liable to decompose it, notably the chlorides.

23. (a) Mercurous and Mercuric.
(b) Refer to lecture.

24 By appearance, solubility, comparative weight, etc.

25. (a) Tartrate of Antimony and Potassium.
(b) Hive Syrup.

Your rating on answers to Lecture 10 *is* 85 *per cent.*

The abbreviations "P.," "Col." and Par.," are used to indicate "page," "column," and "paragraph," respectively.

In rating the answers, your *general understanding of the subjects* and the *appearance of your paper*, are also taken into consideration.

☞ The above questions should be *carefully reviewed* upon receipt of corrections. If questions to any other Lectures remain unanswered, please send them in at once.

THE DIRECTOR.

Always continue to answer in the regular order without waiting for delayed observations. Corrections are always forwarded as promptly as possible.

☞ **NOTICE.—Do not fail to write your name, full address and CLASS page** 627, **at the TOP of the first page of your answers.**

In all correspondence the CLASS page must be stated in order to insure prompt attention.

Dispensing.

DISPENSING.

With the subject of dispensing is intimately connected that of the organization of a pharmacy, the utensils, shelf-bottles, fixtures and its arrangement generally. An adequate description of these can not be given here, and the student is referred to the various works on pharmacy, such as the treatise by Parrish, or "The Practice of Pharmacy," by Remington. Apparatus, involving a knowledge of the principles governing their construction and employment in pharmaceutical processes, such as drug mills, funnels, stills, condensers, etc., have been described in Lectures II and III, in connection with the respective operations.

A pharmacy should be organized from a dispensing standpoint, so as to combine in order of their importance:

(1) Identity and convenience.

(2) Preservation and cleanliness.

Identity is here applied more especially to the arrangement of containers, with a view of preventing mistaking one substance for another; the dispensing of poisons naturally comes under this division. The nomenclature of the labels governs this to a great extent, and if it be perfect and all containers arranged in alphabetic order, the safest plan of preventing mistakes is secured to competent dispensers, while to those less advanced, it is the only true or scientific method entitled to adoption.

Many objections have been urged against this system, the most conspicuous being that the alphabetic arrangement sometimes brings a powerful remedy (heroicum) next to one possessing very mild properties, as, for example, Tinctura Opii and Tinctura Opii Camphorata, etc. This objection, however, can not be sustained, because all poisons and remedies possessing great activity, though not always classed as poisonous (termed *heroica* in the Continental Pharmacopœias) should be kept in containers, whose capacity is commensurate with the smaller quantity required for dispensing purposes, as compared with those used in much larger quantities.

To illustrate the foregoing example, Tinctura Opii, if included in the general arrangement at all, should be kept in a bottle not exceeding one pint capacity, while the container for Tinctura Opii Camphorata should hold at least two pints.

It has also been proposed that the old Latin names, in some cases, be substituted for the Pharmacopœial titles, as, for example, Sal Rochelle and Tartarus Emeticus, instead of their respective officinal chemical names. There are some good reasons for this, in that the officinal names of these two compounds, on containers of nearly the same size, especially if the names be incorrectly abbreviated, may easily be mistaken for each other, viz.: Sod. Pot. Tart. and Ant. Pot. Tart. In view of what has been said, however, such a contingency ought never to arise, because of the great difference in the respective *quantities*, which should be kept on hand of these and other substances bearing a similar relation to each other, for purely dispensing purposes. The plan is, moreover, without justification, for the reason that it would perpetuate arbitrary synonyms without scientific warrant.

A strict adherence to the Pharmacopœial nomenclature, with a faultless abbreviation on all containers, will not only tend to guard against errors in dispensing, but is also desirable because of its great convenience. It enables those familiar with Pharmacopœial nomenclature to find at least officinal substances with ease in any pharmacy, and, while a correct system affords the beginner much instruction and information, a confused or inaccurate one will prove exceedingly inconvenient, annoying, and frequently fraught with serious consequences. But, in order that fatal mistakes may be as far as possible prevented, all substances known as *poisonous* should be kept in separate compartments, preferably under lock and key.

The *isolation* of poisons seems to be the most practicable, as it is the safest method of all the plans proposed, for preventing mistakes of a fatal character in dispensing. As an additional precaution the substances should be left in the original containers, as these usually are each characteristic as to size and proportions, so that one may not be mistaken for another. Of the various devices designed for this purpose, there are containers of colored glass, painted black, covered with sand paper, or provided with odd stoppers with jagged edges to rouse the attention of the dispenser; none of these, it is believed, can be relied upon unless the poisons are also kept in a separate place.

A poison case designed by Mr. H. Biroth (See Proc. Am. Pharm. Assoc., 1884) combines the advantages of being compact and convenient, and well adapted for this purpose.

Upon the theory that mistakes frequently occur because of absent-mindedness on the part of the dispenser, it has been proposed that all poisons be kept in a drawer, in which the containers are promiscuously thrown, thus compelling the dispenser to carefully examine the label for such as may be wanted for use.

PRESERVATION.

The preservation of medicinal agents is a very important part of the pharmacist's duties. Many of them, while originally of good quality, under certain conditions, such as exposure to light, changes in temperature, etc., deteriorate and not unfrequently spoil.

The attention to be observed in the preservation of crude drugs of vegetable origin, has been pointed out in Lecture II, and the requirements in this respect for chemical compounds are indicated under each of these in the previous lectures under their respective characters and behavior, when exposed to the influences above noted, viz.: the action of light and changes in temperature.

But a still more important, if not larger, class of substances are left for consideration, namely, the so-called Galenic preparations, and especially those of a liquid character. Among these, the weaker preparations, that is, solutions not saturated, such as tinctures, spirits, medicated waters, solutions, essential and fixed oils, etc., are, as a rule, preserved without much difficulty, although undue exposure should as far as possible be avoided. This is especially to be observed in fixed and volatile oils, which must be kept in a cool and dark place, and well protected from the atmosphere, in tightly stoppered containers.

Dispensing.—Preservation.

PRESERVATION—(CONTINUED).

In *saturated* solutions preservation is more difficult, especially with compound preparations containing various ingredients, as, for example, Elixirs and Fluid Extracts. In many of these, upon exposure to the slightest change in temperature, some constituent is thrown out of solution, giving to the preparation a cloudy appearance or precipitate, either of which is very undesirable. Such preparations should be kept at a temperature as near as possible to that at which they were prepared.

Syrups and Emulsions, owing to their consistence, rarely precipitate, but, since they do not contain any alcohol, they are liable to ferment or otherwise spoil, when exposed to warmth, and they should therefore be stored in a cool place.

The ordinary glass-stoppered bottles are not appropriate for syrups, because of the caking of the syrup in the neck of the bottle, making the withdrawal of the stopper exceedingly difficult and sometimes at the danger of fracturing the container. To avoid this difficulty, so called "syrup bottles" are sometimes used for containers, in which the stoppers rest loosely upon the enlarged neck of the bottle, inside of which the stopper proper is suspended without coming in contact with the sides. The objection to this form of container is, that the air is not excluded, and the syrup is therefore liable to spoil. The best kind of containers for syrups and all saccharine liquids are ordinary bottles with corks and written labels; these are more convenient, are easily cleaned, and, in case of breakage, are comparatively inexpensive; besides, the syrup may be poured into them whilst hot, without destroying the label.

The *preservation of fluid extracts* presents probably more difficulties than any other single class of preparations, for the reason that they are usually saturated solutions of organic substances or principles, which, upon the slightest exposure, and frequently without exposure, become insoluble, and are thrown out of solution until heavy precipitates are formed. This precipitation often continues until a very large proportion of the extracted matter, which usually represents the most valuable principles of the drug, is precipitated, and the preparation becomes more or less inert.

This precipitation is sometimes due to exposure to changes in temperature, but most frequently to the employment of menstrua not capable of holding the extracted matter in solution. Other causes, however, at present not known, also operate to induce this change, which is singular in that when it has commenced it continues to develop, and the precipitate can not be redissolved without largely increasing the quantity of liquid. To prevent precipitation these preparations should be kept at even temperature, preferably about 60° F., and care should be taken that the proper menstrua be employed in their manufacture The containers should be ordinary bottles, preferably of amber glass, so as to exclude the actinic rays of sunlight, which appear to have a decomposing action upon preparations containing a large proportion of chlorophyll; they should also be provided with tight-fitting corks, so as to prevent evaporation of the alcohol. Different lots of fluid extracts of the same drugs should never be mixed, as the slightest change in the alcoholic strength of the menstrua in different specimens will induce precipitation.

The *preservation of solids*, embracing also mixtures of solid substances in various forms, such as cerates and ointments, while not as difficult to accomplish as with preparations in the liquid form, deserves considerable attention, because their preservation involves also, to a great extent, a feature very essential in the practice of pharmacy, namely, *cleanliness*.

With Extracts (solid) it is especially to be observed that they should be kept in a cool and dry place. Those made with aqueous menstrua, such as extract of taraxacum, are liable to ferment, when they swell and exude around the cover of the jar, defacing the label and the furniture. Extracts made with alcoholic menstrua, such as aconite, nux vomica, etc., by exposure to a warm temperature, become dry and hard, rendering their dispensing difficult. Both of these undesirable tendencies of the extracts have, to some extent, been counteracted by officially directing the incorporation of five per cent. of glycerin in many of them when prepared, but glycerin readily absorbs moisture, and its presence in extracts, which are also naturally hygroscopic, increases this quality, hence the necessity of storing extracts in a *dry* place.

These observations apply also to Abstracts, Masses, Confections, Pills, and all the various classes of preparations included in mixtures of solids.

With preparations of an *oleaginous* character the same general rule is applicable as to high temperature and moisture. Many Cerates and Ointments, however, are prone to become rancid with the best of precautions, and they should be prepared either in very small quantities only, or, as in the case of Cerate of Lead Subacetate, be prepared extemporaneously.

GENERAL DISPENSING.

The dispensing of liquids, notwithstanding the general introduction of parts by weight in the U. S. Pharmacopœia, is done by measure—except with a few substances, such as glycerin, ether, etc., when sold in considerable quantities.

The measures in use are chiefly of glass, as described in Lecture I, graduated either according to the U. S. fluid measure, the Metric system in cubic centimeters (or fluigrams), or according to both upon opposite sides. (See Lecture I; also Remington's or Parish's Pharmacy for full description).

In dispensing a mixture of any character, the dispenser should ascertain, first of all, that every article required for its completion is on hand.

The practice, however, of taking down all containers at one time, which is sometimes done with this object in view, so as to place them within easy reach, is not to be recommended, for reasons explained under the dispensing of prescriptions.

The next step is to provide the bottle or container with a good cork, which should fit accurately; the very best quality of corks will be found the cheapest in the end; nothing is so apt to displease a patron as to find a poor, worm-eaten or short-cut cork in a bottle, when it can only be replaced with considerable inconvenience.

Dispensing.—Prescriptions.

In *measuring* a liquid into a "graduate" from a shelf-bottle, care should be observed that:

(1). The measure be held by grasping the foot or base firmly between the thumb and the index finger of the left hand, bringing it up so as to be on a level with the eye.

(2). The container is taken down from the shelf, after the label has first been carefully read, with the right hand placed near the bottom.

(3). The stopper is then clasped between the free little finger and the left hand, extracted, and the contents poured into the measure with great exactness.

(4). The remaining drop upon the lip of the bottle is then, by a dexterous movement, wiped off on the stopper, the latter inserted, and the container placed back on the shelf, after again carefully reading the label.

(5). The liquid having been poured in, the bottle is carefully stoppered with a cork, the top extending so that it may be easily extracted with the fingers, but yet so secure that any jolting the package may receive will not be sufficient to dislodge it.

Labeling is also an important part of dispensing. The label should be plain and printed in black ink, except with those for poisons, which may be in red ink. When blank labels are used, the name should be written in a bold and legible handwriting, without flourish.

Labels should, as far as practicable, contain such information as may be desirable for an intelligent use of the article; for example, with glycerin, "that it be diluted with a little water before applying it to raw surfaces," or with castor oil how the taste may be best masked, etc. With all powerful remedies the labels should bear the doses, with some injunction that care must be observed in its employment, at least when for internal use.

The paste should combine adhesiveness, cleanliness and cheapness; dextrin mucilage possesses these qualities better than any made from acacia, tragacanth or flour. It is prepared by heating four ounces of dextrin in eight ounces of water and one ounce of acetic acid until it is dissolved; when one ounce of alcohol is added, which preserves it and causes it to dry rapidly. This mucilage is used for gumming postage stamps.

In labeling a bottle, the label should be affixed, if the proportions admit, so that the center of the label will be about three-fifths the distance from the bottom of the bottle. It must never be placed across the seam on round vials, but exactly between the two seams, and should always be perfectly horizontal.

Dispensing of Solids.

The dispensing of solids, to be treated in this connection from a purely mechanical standpoint requires no special observation, as it involves merely weighing and making packages.

The former having been referred to in Lecture I, only the latter subject will be briefly noticed here.

"Wrapping packages," as it is called, though apparently a trivial performance, is one to which considerable importance is attached by expert pharmacists, and when carried to perfection becomes an art, which even the public does not fail to appreciate. The exterior of packages, no less than of the dispenser himself, tends to influence a favorable impression of the skill of the pharmacist and promote personal confidence and esteem. This to the pharmacist is of incalculable value, and, as the extra outlay is slight, it is well worthy his consideration.

The *art of wrapping* a package artistically may easily be acquired by any one possessing adaptability and patience; but as success depends chiefly upon practice and experience, the subject can not be treated here, except in calling attention to a few general rules to be observed. These are:

(1). Suitable paper.

None with ragged edges should ever be used, except for heavy goods, when old wrapping paper may be employed.

(2). Paper of proper size.

An assortment of different sizes should invariably be kept on hand, in compartments under the counter, convenient to the scales.

(3). Properly folded.

The package to be so made, that the center of the double crease shall be exactly in the center of the package, the ends folded over so as to present a perfectly square knife-edge, and so far, that their ends meet. The package should be plump and nearly square, rather than flat and long. Many articles can not be wrapped so as to conform to these general directions, but with most crude drugs, this method gives a package of correct proportions and neat appearance.

(4). Correctly labeled.

It is necessary that packages of solid substances be labeled, as bottles containing liquids, although, except in the case of poisons, it is usually neglected. The label should be placed immediately over the center of the double crease, and attached with the smallest quantity of paste, barely sufficent to prevent it from slipping off. This enables the purchaser to easily remove it and attach it to a container.

(5). Securely tied.

When the package is made, and while it is lying upon the counter right side up, the twine is laid over it along the double crease and then turned over with both hands, the twine being held in position during this operation. After the twine has been crossed in the center this operation is repeated transversely, and the twine then tied in a *bow* knot at the side. This operation can be performed very quickly, and at no time is it necessary to lift the package more than a few inches from the counter, while the exceedingly awkward habit of placing the twine between the teeth is avoided.

Prescriptions.

Prescription is literally a written order for something—from *præ*, for, and *scribo*, I write. Its popular use, however, relates to medicines, usually meaning a written order for medicines, though it is frequently employed to designate the remedy or mixture itself. In *reading* prescriptions the most important considerations are:

(1). The language and abbreviations.

(2). The signs and terms.

The *language* of prescription-writing is primarily Latin, because the pharmacopœial titles are chiefly used in designating remedies. In other features, however, such as directions for compounding and for use, Latin is rarely employed in America, and when used, is most frequently of a character which suggests that it be abolished, because no good grounds exist for encouraging its use.

Latin.—Nouns.

Latin in Pharmacy.

A nomenclature that can be understood by the pharmacists of all civilized nations, is as important to the profession of pharmacy as a scientific nomenclature of animals and plants is to the zoologist and botanist.

Because it is a language with which most scholars are familiar and because of its flexibility, as well as for other good reasons, Latin has by common consent been adopted in the naming of drugs and pharmaceutical preparations. Besides, it is a common, though by no means universal practice, for physicians to write their prescriptions in Latin.

An elementary knowledge of the language is, therefore of considerable importance to the pharmacist. We can not, of course, undertake here to give the student a course in Latin. All that can be done is to give such hints and suggestions as will be of the most practical importance, and will smooth the way somewhat for those who desire to make themselves better acquainted with the language, and have not, at the same time, the advantage of attending schools where Latin is taught.

In its structure the Latin language differs markedly from our own. The Latin *order* differs quite widely from ours, as is illustrated by the following sentence: *Viri boni sunt*, which means *They are good men*, but if the words be literally translated and the Latin order preserved, the sentence would read *Men good they are.*

A still more important difference between the Latin and our language, consists in the *inflections*. Latin has many inflections, our language but few.

Take, for example, the noun *mixture*. We suffix an *s* to it to express more than one, an apostrophe and an *s* to express the singular possessive, and an *s* followed by an apostrophe to express the plural possessive, but further than this the form of the word itself is not changed to express different shades of meaning, but the object is accomplished by the use of prepositions placed before the noun. Not so with the Latin equivalent, *mistura*. This is inflected as follows:

Singular Number.

Nominative case.		Mistura, a mixture.
Genitive	"	Misturae, of a mixture.
Dative	"	Misturae, to a mixture.
Accusative	"	Misturam, a mixture.
Vocative	"	Mistura, thou mixture !
Ablative	"	Mistura, with a mixture,

Plural Number.

Nominative case.		Misturae, mixtures.
Genitive	"	Misturarum, of mixtures.
Dative	"	Misturis, to mixtures.
Accusative	"	Misturas, mixtures.
Vocative	"	Misturae, ye mixtures !
Ablative	"	Misturis, with mixtures.

It will be seen that there are more cases than in English, and that the same noun, to express its different relations in the sentence, has several different endings.

But not all Latin nouns are declined like *Mistura*. In fact, there are five different declensions of Latin nouns, called respectively the First, Second, Third, Fourth and Fifth declensions. The last two include but few words, and may be left out of consideration in this brief account. Mistura is an example of a noun of the first declension, and is typical of its class. Most nouns of this declension are feminine and terminate in *a*.

Nouns of the second declension are some of them masculine and some neuter. The former have their nominative terminating in *us*, *er* and *ir*, while the latter have their nominative terminating in *um*.

Syrupus may be taken as an example of a masculine noun of the second declension, and is declined as follows:

Singular Number.

Nominative case.		Syrupus, a syrup.
Genitive	"	Syrupi, of a syrup.
Dative	"	Syrupo, to a syrup.
Accusative	"	Syrupum, a syrup.
Vocative	"	Syrupe, thou syrup.
Ablative	"	Syrupo, with a syrup.

Plural Number.

Nominative case.		Syrupi, syrups.
Genitive	"	Syruporum, of syrups.
Dative	"	Syrupis, to syrups.
Accusative	"	Syrupos, syrups.
Vocative	"	Syrupi, ye syrups !
Ablative	"	Syrupis, with syrups.

Vinum may be taken as an illustration of the neuter noun of the second declension. It is declined as follows:

Singular Number.

Nominative case.		Vinum, wine.
Genitive	"	Vini, of wine.
Dative	"	Vino, to wine.
Accusative	"	Vinum, wine.
Vocative	"	Vinum, thou wine !
Ablative	"	Vino, with wine.

Plural Number.

Nominative case.		Vina, wines.
Genitive	"	Vinorum, of wines.
Dative	"	Vinis, to wines.
Accusative	"	Vina, wines.
Vocative	"	Vina, ye wines !
Ablative	"	Vinis, with wines.

Nouns of the third declension may be either masculine, feminine or neuter, and the terminations of the nominative are various.

Pulvis (a powder) may be taken as an example of a masculine noun of this declension. It is declined as follows:

Singular Number.

Nominative case.		Pulvis, a power.
Genitive	"	Pulveris, of a powder.
Dative	"	Pulveri, to a powder.
Accusative	"	Pulverum, a powder.
Vocative	"	Pulvis, thou powder !
Ablative	"	Pulvere, with powder.

Plural Number.

Nominative case.		Pulveres, powders.
Genitive	"	Pulverum, of powders
Dative	"	Pulveribus, to powders.
Accusative	"	Pulveres, powders.
Vocative	"	Pulveres, ye powders !
Ablative	"	Pulveribus, with powders.

Inflection of Adjectives.

Adjectives are either masculine, feminine or neuter to agree with the nouns which they qualify or limit. For instance, *bonus*, *bona*, *bonum* are respectively the masculine, feminine and neuter of the adjective *good.*

Most adjectives, whose nominative masculine singular ends in *us* or *er*, have this gender inflected like a masculine noun of the second declension, the feminine gender, whose nominative singular ends in *a*, is inflected like a noun of the first declension, and a neuter, whose nominative singular ends in *um*, is declined like a neuter noun of the second declension.

Latin—Continued.

The adjective *albus*, white, is declined as follows:

Singular.

Case.	*Masculine.*	*Feminine.*	*Neuter.*
Nom.	albus	alba	album.
Gen.	albi	albae	albi.
Dat.	albo	albae	albo.
Acc.	album	albam	album.
Voc.	albe	alba	album.
Abl.	albo	alba	albo.

Plural

Nom.	albi	albae	alba.
Gen.	albornm	albarum	albornm.
Dat.	albis	albis	albis.
Acc.	albos	albas	alba.
Voc.	albe	albae	alba.
Abl.	albis	albis	albis.

There are other adjectives belonging to the third declension, the inflections of which are illustrated by the following example:

Singular.

Case.	*Masculine.*	*Feminine.*	*Neuter.*
Nom.	acer	acris	acre.
Gen.	acris	acris	acris.
Dat.	acri	acri	acri.
Acc.	acrem	acrem	acre.
Voc.	acer	acris	acre.
Abl.	acri	aeri	acri.

Plural

Nom.	aeres	acres	acria.
Gen.	aerium	acrium	acrium.
Dat.	acribus	acribus	acribus.
Acc.	acres (is)	acres (is)	acria.
Voc.	acres	acres	acria.
Abl.	acribus	acribus	acribus.

The student will readily perceive the analogy between the inflections of adjectives of this declension and those of nouns of the same declension, and will also readily understand such botanical names as *Polygonum acre* and *Ranunculus acris*. *Acre* is the nominative singular neuter of the adjective *acris*, and it means acrid or biting, in allusion to the acrid properties of that plant. It is neuter, of course, to agree with the neuter noun Polygonum. So, in the second case, *acris* is the masculine form of the same adjective, and agrees with the masculine noun Ranunculus. The adjective *albus* (white) also is frequently used in botany as a specific name, and it will take the form of *albus*, *alba* or *album*, according as its noun is masculine, feminine or neuter.

The scientific name of a plant or animal consists, in the majority of cases, of a noun (the first or generic name), which is qualified by an adjective (the specific or last name), as in the above examples. But this is not always the case. Sometimes the specific name is a noun in opposition with the generic name, as in the following examples: Pimpinella Anisum, Exogonium Purga, and Strychnos Ignatia. In such cases it will be observed that the specific name is written with a capital. Sometimes, also, when the name of the discoverer is commemorated in the specific name of the plant, the latter is placed in the genitive case, as Ranunculus Nuttalii, meaning the Ranunculus of Nuttall. In this case, as in the previous one, the specific name is always written with a capital. But in other cases it is written with a small letter.

Different forms of the adjective are also used in Latin to express the positive, comparative and superlative degrees. Where the comparison is regular, the comparative is formed by suffixing *ior*, and the superlative by suffixing *issimus* to the stem of the positive, as, *altus* (high); *altior* (higher); *altissimus* (highest). But it is sometimes irregularly formed, as in bonus (good) and malus (bad) *bonus, melior, optimus:* and *malus, pejor pessimus.*

Inflection of Pronouns.

The first personal pronoun is inflected thus:

Case.	*Singular.*	*Plural.*
Nom.	ego, I	nos, we.
Gen.	mei. of me	nostrum, nostri, of us.
Dat.	mihi, to me	nobis, to us.
Acc.	me	nos, us.
Abl.	me, by me	nobis, by us.

The second personal pronoun is thus inflected:

Nom.	tu, thou	vos, ye or you.
Gen.	tui, of thee	vestrum, vestri, of you.
Dat.	tibi, to thee	vobis, to you.
Acc.	te, thee	vos, you.
Voc.	tu, O thou	vos, O ye or you.
Abl.	te, by thee	vobis, by or with ye or you.

In Latin there are no personal pronouns of the third person corresponding to *he*, *she*, *it* and *they*, but their place is sometimes taken by a demonstrative pronoun.

The following is the declension of the demonstrative *hic* (this):

Singular.

Case.	*Mas.*	*Fem.*	*Neuter.*
Nom.	hic	haec	hoc.
Gen.	hujus	hujus	hujus.
Dat.	huic	huic	huic.
Acc.	hunc	hanc	hoc.
Abl.	hoc	hac	hoc.

Plural (these).

Nom.	hi	hae	haec.
Gen.	horum	harum	horum.
Dat.	his	his	his
Acc.	hos	has	haec.
Abl.	his	his	his.

The demonstrative *is* (that) is thus declined:

Singular.

	Mas.	*Fem.*	*Neut.*
Nom.	is	ea	id.
Gen.	ejus	ejus	ejus.
Dat.	ei	ei	ei.
Add.	eum	eam	id.
Abl.	eo	ea	eo.

Plural (those)

	Mas.	*Fem.*	*Neut.*
Nom.	ii (or ei)	eae.	ea.
Gen.	eorum	earum	eorum.
Dat.		eis (or iis)	
Acc.	eos	eas	ea.
Abl.		eis (or iis)	

Ille (that) is inflected as follows:

Singular.

	Mas.	*Fem.*	*Neut.*
Nom.	ille	illa	illud.
Gen.	illius.	illius.	illius.
Dat.	illi	illi	illi.
Acc.	illum	illam	illud.
Abl.	illo	illa	illo.

Ipse (self) and *iste* (that) are similarly inflected. The plurals of the last three are regular, and declined like *albus*.

The relative pronoun *qui* (who, which) is declined as follows:

Singular.

Case.	*Mas.*	*Fem.*	*Neut.*
Nom.	qui	quae	quod.
Gen.	cujus	cujus	cujus.
Dat.	cui	cui	cui.
Acc.	quem	quam	quod.
Abl.	quo	qua	quo.

Plural.

Nom.	qui	quae	quae.
Gen.	quorum	quarum	quorum.
Dat.	quibus	quibus	quibus.
Acc.	quos.	quas	quae.
Abl.	quibus	quibus	quibus.

Latin Verbs.

LATIN VERBS.

These pass through a still greater number of changes of form to express different shades of meaning and their relations to the subject. Verbs in Latin, as in English, have voice, mode, tense, person and number, but instead of expressing changes in these mainly by auxiliary verbs, as we do, the Latins expressed theirs chiefly by initial or terminal changes.

The verb *to be*, for instance, is very irregular in English, but its changes of form, or inflections, are far more numerous in Latin, as will be seen by the following synopsis of its forms:

PRINCIPAL PARTS.

Present.	*Infinitive.*	*Perfect.*	*Future Part.*
sum.	esse.	fui.	futurus.

INDICATIVE MODE.

PRESENT.

Singular Number.	*Plural Number.*
1st person—sum, I am.	1st person—sumus, we are.
2d " es, thou art.	2d " estis, you are.
3d " est, he (she or it) is	3d " sunt, they are.

IMPERFECT.

Singular.	*Plural.*
1. eram, I was.	1. eramus, we were.
2. eras, thou wast.	2. eratis, you were.
3. erat, he (she or it) was	3. erant, they were.

FUTURE.

Singular.	*Plural.*
1. ero, I shall be.	1. erimus, we shall be.
2. eris, thou wilt be.	2. eritis, you will be.
3. erit, he will be.	3 erunt, they will be.

PERFECT.

Singular.	*Plural.*
1. fui, I have been.	1. fuimus, we were.
2. fuisti, thou hadst been.	2. fuistis, you were.
3. fuit, he has been.	3. fuerunt, they were.

PLUPERFECT.

Singular.	*Plural.*
1. fueram, I had been.	1. fueramus, we had been.
2. fueras, thou hadst been.	2. fueratis, you had been.
3. fuerat, he had been.	3. fuerant, they had been.

FUTURE PERFECT.

1. fuero, I shall have been.	1. fuerimus, we shall have been.
2. fueris, thou shalt have been.	2. fueritis, you will have been.
3. fuerit, he will have been.	3. fuerint, they will have been.

SUBJUNCTIVE MODE.

PRESENT.

Singular.	*Plural.*
1. sim, I may be	1. simus, we may be.
2. sis, thou mayst be.	2. sitis, you may be.
3. sit, he may be.	3. sint, they may be.

IMPERFECT.

Singular.	*Plural.*
1. essem, I should be.	1. essemus, we should be.
2. esses, you would be.	2. essetis, you would be.
3. esset, he would be.	3. essent, they would be.

PERFECT.

Singular.	*Plural.*
1. fuerim, I may have been.	1. fuerimus, we may have been.
2. fueris, thou mayst have been.	2. fueritis, you may have been.
3. fuerit, they may have been.	3. fuerint, they may have been.

IMPERATIVE MODE.

PRESENT.

Singular.	*Plural.*
es, be thou.	este, be ye.

FUTURE.

Singular.	*Plural.*
2. esto, thou shalt be.	2. estote, ye shall be.
3. esto, he shall be.	3. sunto, they shall be.

INFINITIVE MODE.

Present—esse, to be.
Perfect—fuisse, to have been.
Future—futurus esse, to be about to be.
Future Participle—futurus, about to be, which is declined like an adjective.

As the verb, *fio*, to be made, is usually met with in some of its forms in prescriptions, it will be of interest to the student to know its inflections, and a synopsis of its forms will therefore be given.

Although it is somewhat irregular, and is lacking in some of the parts which belong to regular verbs like *amo*, *facio*, etc., it will convey to the student a fair idea of the inflections of Latin verbs generally.

PRINCIPAL PARTS.

Fio, fieri, factus sum.

INDICATIVE.

PRESENT.

Singular.	*Plural.*
1. fio, I am made.	1. fimis, we are made.
2. fis, thou art made.	2. fitis, you are made.
3. fit, he is made.	3. fiunt, they are made.

IMPERFECT.

1. fiebam, I was made.	1. fiebamus, we were made.
2. fiebas, thou wast made.	2. fiebatis, you were made.
3. fiebat, he was made.	3. fiebant, they were made.

FUTURE.

1. fiam, I shall be made.	1. fiemus, we will be made.
2. fies, thou wilt be made.	2. fietis, you will be made.
3. fiet, he will be made.	3. fient, he will be made.

PERFECT.

Sing. 1. factus sum, I have been made.
2. factus es, thou hast been made.
3. factus est, he has been made.

Plur. 1. facti sumus, we have been made
2. facti estis, you have been made.
3. facti sunt, they have been made.

PLUPERFECT.

Sing. 1. factus eram, I had been made.
2. factus erat, thou hadst been made.
3. factus erat, he had been made.

Plur. 1. facti eramus, we had been made.
2. facti eratis, you had been made.
3. facti erant, they had been made.

FUTURE PERFECT.

Sing. 1. factus ero, I shall have been made.
2. factus eris, thou wilt have been made.
3. factus erit, he will have been made.

Plur. 1. facti erimus, we shall have been made.
2. facti eritis, you will have been made.
3. facti erint, they will have been made.

Latin—(Concluded).

SUBJUNCTIVE MODE.

PRESENT.

Sing. 1. fiam, I may be made.
2. fias, thou mayst be made.
3. fiat, he may be made.

Plur. 1. fiamus, we may be made.
2. fiatis, you may be made.
3. fiant, they may be made.

IMPERFECT.

Sing. 1. fierem, I might be made.
2. fieres, thou mightst be made.
3. fieret, he might be made.

Plur. 1. fieremus, we might be made.
2. fieretis, you might be made.
3. fierent, they might be made.

PERFECT.

Sing. 1. factus sim, I may have been made.
2. factus sis, thou mightst have been made.
3. factus sit, he might have been made.

Plur. 1. facti simus, we might have been made.
2. facti sitis, you might have been made.
3. facti sint, they might have been made.

PLUPERFECT.

Sing. 1. factus essem, I might have been made.
2. factus esses, thou mightst have been made.
3. factus esset, he might have been made.

Plur. 1. facti essemus, we might have been made.
2. facti essetis, you might have been made.
3. facti essent, they might have been made.

IMPERATIVE MODE.

PRESENT.

Sing. fi, be thou made.
Plur. fite, be ye made.

INFINITIVE MODE.

Pres. fieri, to be made.
Perf. factus esse, to have been made.
Fut. factum iri, to be about to be made.

PARTICIPLES.

Perf. factus, having been made.
Fut. faciendus, to be made.

For the sake of illustrating the use of Latin in prescription writing, the following example is given:

℞ *Acid. Arsenios.* gr. j.
Ferri Pyrophos. ℥ ß.
Res Podophyl. gr. v.
M. S. A.
ft Mas et div in pil xx
S. Una pil detur bis in die

Unabbreviated the same prescription would read as follows:

Recipe: Acidi arseniosi granum unum, ferri pyrophosphatis drachmam semis, et resinae podophylli grana quinque. Misce secundem artem, fiat massa, et divide in pilulas viginti.

Signa: Una pilula detur bis in die.

Literally translated it reads as follows; Take thou of acid arsenious grain one, of iron pyrophosphate, dram a half, and of resin of podophyllum grains five. Mix according to art, let be made a mass, and divide into pills twenty.

Write: One pill let be given twice in a day.

Or putting the translation in the proper English order the prescription will read:

Take of arsenious acid a grain, of pyrophosphate of iron half a dram, and of resin of podophyllum five grains. Mix according to art, let a mass be made, and divide into twenty pills.

Write: Let one pill be given twice a day.

ANALYSIS.

Recipe is a verb in the active voice, imperative mode, present tense, second person, and singular number; agreeing with *tu* (thou) understood.

Acidi is a neuter noun of the second declension, in the singular number and genitive case.

Arseniosi is an adjective agreeing with its noun, *acidi*, in gender and number and case.

Granum is a noun of the second declension, neuter gender, singular number and accusative ease, the direct object of the word *Recipe*.

Unum is a numeral adjective agreeing with its noun granum in gender and number and case.

Ferri is a neuter noun of the second declension, in the singular number and genitive case.

Pyrophosphatis is a masculine noun of the third declension in the singular number and genitive case.

Drachmam is a feminine noun of the first declension in the singular number and accusative case, and governed like *granum*.

Semis is a numeral adjective agreeing with its noun drachmam in gender, number and case.

Et is the conjunction *and*, connecting the preceding two clauses to the one following.

Resinae is a feminine noun of the first declension, in the singular number and genitive case.

Podophylli is a neuter noun of the second declension in the singular number and genitive case.

Grana is a neuter noun of the second declension found in the plural number and accusative case.

Quinque is a numeral adjective qualifying granas.

Misce is a verb (from misceo) in the active voice, imperative mode, present tense, second person, singular number, agreeing with *tu* (thou) understood.

Secundem is a preposition governing.

Artem, which is a noun of the third declension, singular number, feminine gender and accusative case.

Fiat is a verb (from fio) in the active voice (in form though not in meaning), subjunctive mode, present tense, third person, singular number, agreeing with its subject, massa.

Massa is a feminine noun of the first declension, singular number and nominative case, the subject of *fiat*.

Et is a conjunction connecting *misce* and *divide*.

Divide is a verb (from dividco) in the active voice, imperative mode, present tense, second person, singular number, agreeing with *tu* understood.

In is a preposition governing pilulas.

Pilulas is a feminine noun of the first declension in the plural number, accusative case and governed by *in*.

Viginti is a numeral adjective qualifying pilulas.

Signa is a verb (from signo) in the active voice, imperative mode, present tense, second person, singular number, and agrees with its subject *tu* understood.

Una is a numeral adjeetive, feminine gender, singular number, and nominative case, qualifying pilula.

Pilula is a feminine noun of the first declension in the singular number and nominative case, the subject of the verb *detur*.

Detur is a verb (from do) passive voice, subjunctive mode, present tense, third person, singular number, and agrees with its subject, *pilula*.

Bis is an adverb modifying *detur*.

In is a preposition governing *die*.

Die is a noun of the fifth declension, masculine (or feminine) gender, third person, singular number and ablative case, governed by the preposition *in*.

Prescriptions.

A prescription may be divided into five parts, as follows :

(1) The superscription = ℞. For.....

(2) The inscription, i.e.: { Tincturæ opii... ℥ i / Syrupi ..... ℥ i / Aquæ cinnamomi ℥ i

(3) The subscription, i. e. : misce.

(4) The signa, i. e. : Sig. One teaspoonful every hour.

(5) The name of the prescriber and date.

The *superscription* consists only of the mark ℞, an abbreviation of the imperative of the verb recipio—*recipe*, which means "take thou."

The *inscription* is the most important part of the prescription, because it embraces the names of the different ingredients and their quantities, which are written in the genitive :

℞ Quininæ sulphatis—Take (thou, being understood) of sulphate of quinine.

The rule is, therefore, that every word in the inscription must terminate in the *genitive.*

They are rarely written out in full, however, but are nearly always abbreviated. In the case of words having the first, or first and second, syllables the same, as, for example, Hydrargyrum and Hydrastis, the abbreviation must not be carried so far as to involve doubt as to what substance is really wanted. To illustrate, the drugs just named are often abbreviated Hydr., which may mean either of them, or, when followed with chlor., would mean hydrate of chloral (chloral), but might also be mistaken for hydrargyrum chloridum ; both calomel and mercurie chloride (corrosive sublimate) being sometimes very improperly, though not unfrequently, so written. In such cases the dispenser must carefully judge what article is intended by computing the dose and from the other ingredients.

In compounds or mixtures the ingredients may be classified from the standpoint of prescribing into : (a) The base or active constituents. (b) The forming substance. This is variously termed according to the form or consistence of the mixture : For liquids and ointments—*vehicle*, i. e., syrup and petrolatum respectively ; in the form of powder—*diluent*, i. e., milk sugar, and when in a mass, as in the form of pills or troches—*excipient.* (c) The *corrective* is the addition of any agent which modifies the action of the active ingredient, as, for example, syrup of ginger in some mixtures, or capsicum in purgative pills. (d) *Adjuvant* is a term given to such ingredients as may be added to increase the action of the base, but since these frequently are quite as potent as the principal remedy, the distinction is rarely made, and not here considered.

These divisions are illustrated as follows :

Form.	Base.	Vehicle.	Diluent.	Excipient.	Corrective.
Liquid....	Potassii iodidi.	Aquæ. Syrupi.	.....	.....	Tinct. Zingib'r
Powder...	Hydrargyri chloridi mite.	.....	Sacch'ri lactis.		
Pill.....	Hydrargyri chloridi corrosivi	.....	Pulvis althææ.	Glyc'rit. amyli.	
Ointment.	Zinci oxidi.	Ung'nti benz'ni.			

The *subscription* consists of signs or terms conveying directions as to the compounding and dispensing. When only one substance is prescribed, it is usually omitted ; in the case of mixtures of liquids or solutions, the mark M, or *misce* (mix) is generally affixed.

In case no especial directions are given, the pharmacist must employ his skill in compounding the mixture, that, not only will the full medical effects be derived, but when possible also, that it be presented in the most agreeable and palatable form, expressed in the term *secundem artem.*

The *signa* or the directions to be written on the label and affixed to the package or container. These are usually written in English, though sometimes, especially by European physicians, in Latin. There is no good reason for writing the directions other than in English, and in a plain, bold handwriting. No secresy is here necessary, as is sometimes desirable in the inscription. On the other hand, it may serve as a check upon any errors on the label incidental to dispensing. Abbreviated terms should be carefully scrutinized when employed, before writing the label, and the stereotyped expression, "Use as directed," should as far as possible be avoided. Many serious consequences might have been averted, if concise directions were given.

The following Latin terms, more or less abbreviated, are used in the directions :

Bis in die.	Bis in d.	Twice a day.
Capiat.	Cap.	Let him (or her) take.
Coehleare.	Coch., Coehl.	A spoonful.
Cochleare magnum	Coch. mag.	Tablespoonful.
Cochleare medium	Coch. med.	Dessertspoonfu.
Cochleare parvum	Coch. parv.	Teaspoonful.
Da, detur.	D., det.	Give, let be given.
Dentur tales doses.	Dent. tal. dos.	Give of such doses.
Diebus alternis.	Dieb. alt.	Every other day.
Diebus tertiis.	Dieb. tert.	Every third day.
Dimidius.	Dim.	One-half.
Donec.		Until.
Durante dolore.		While the pain lasts
Harum pilularum sumantur tres.	Har. pil. sum. iii.	Let three of these pills be taken.
Hora.	H.	An hour.
Hora somni.	H. S., Hor. Som.	Before retiring.
In dies.	Ind.	From day to day.
Inter.		Between.
Magnus.	Mag.	Large.
Mane, mane primo.		In the morning.
Modo præscripto.	Mod. præscript.	In the manner prescribed.
More dietu.	More diet.	In the manner directed.
Ne tradas sine nummo.	Ne. tr. S. num.	Do not deliver unless paid.
Nox, noctis.		Night.
Numerus.	No.	Number.
Omni hora.	Omn. hor.	Every hour.
Omni bihorio.	Omn. bihor.	Every two hours.
Omni quadrantehoræ.	Omn. quadr. hor.	Every quarter of an hour.
Omni mane.		Every morning.
Omni nocte.		Every night.
Primus.		The first.
Pro re nata.	P. r. n.	Occasionally.
Quantum libet, placet, vis. volueris.	Q. l., Q. p., Q. v.	As much as you please.
Quaqua, quaque.		Each or every.
Semis.	Ss.	A half.
Septimana.		A week.
Sesquihora.		An hour and a half.
Statim.	Stat.	Immediately.
Ter.		Three times.
Ter in die, ter die.	T. i. d., t. d.	Three times a day.
Ut dictum.	Ut dict.	As directed.
Utendum.	Utend.	To be used.

Prescriptions—(Continued).—Compounding.

The *name of the prescriber* and the date are frequently omitted, or at best, the former is given in initials only.

Since pharmacists are usually enabled to identify the prescriber by the handwriting, the initials often suffice, especially since blanks with printed name, address and office hours are to a great extent employed. A much safer plan, however, is to write the name in full, so that errors may be avoided in writing the label.

The *date* should be affixed at the time of dispensing by the pharmacist, so that its omission is of little importance.

Signs or *symbols* are used to designate quantities, and therefore belong to the inscription, but are more conveniently treated separately.

Those used for designating weights apply only to Troy weights, and of these the "scruple" and "pound" are going rapidly out of use. For liquids the signs represent only U. S. fluid measures, excepting the "drop," *gutta*, plur. *guttæ*, abbreviated "gtt.," which is too indefinite to warrant employment, and should be discarded in favor of the *minim*.

These are too well known to require description here.

Quantities are always expressed in the Roman numerals, which answer this purpose better than the Arabic figures used in all modern languages, including our own.

The numerals i—one; v—five; x—ten; l—fifty; C—one hundred; D—five hundred and M—one thousand, are the basis upon which this system is constructed. It has a symbol for each decimal unit; also one for its first aliquot division or five times the lowest preceding one as shown above. From these the intervening numbers are constructed by placing the different numerals side by side: i=1; v=5; x=10; vi=6; xv=15; xvi=16; xx=20; xxvi=26.

No numeral is used in sequence, however, more than three times, below one hundred; a higher number is constructed by placing the next lowest units *after* the lower one, for example: iv=4; ix=9; xl=40; XC=90. Very cautious prescribers, it may be added, frequently use the full word in preference to any abbreviation.

The terms and abbreviations in *metric* prescription writing, were treated under the Metric Weights and Measures, in Lecture I.

Signs for designating the measure or weight of the mixture, are sometimes affixed to the last ingredient; of these the most important are:

Ad, the preposition "to"; ad ʒ iv=to (measure) four fluid ounces.

Quantum sufficiat, or quantum satis, usually abbreviated Q. S. or q. s.—as much as is sufficient.

Of these the last should always be preferred; *ad*, being rather indefinite, should never be used, as it invites error.

Ana, abbreviated *aa*, of each, is appended when the same quantities are required of two or more ingredients; it follows the last of these, preceding the quantity.

Dentur tales Doses no.—Let there be given of such doses number—, is a phrase used, especially by foreign physicians, to designate the number of powders to be dispensed, *each* containing the quantities directed in the inscription.

Sic, *Statem* or the exclamation sign (!) after the quantity, indicates that the dose is exceptionally large, but that the prescriber is aware of this fact and directs the stated quantity for special reasons.

The more general adoption of signs like these would be very desirable, as their presence is exceedingly reassuring to the dispenser, when powerful remedies are prescribed; the first mentioned, *sic*, should be give the preference, as it is less liable to be confounded for a numeral, than the exclamation point (!).

The Compounding of Prescriptions.

The compounding of prescriptions is the most responsible duty of the pharmacist. It is also the most difficult to fulfill properly, because it involves not only professional skill, but also a good, mature judgment, a cool head and a collected mind.

Probably no other division of human labor makes demands simultaneously upon the exercise of so many faculties, as are required of the pharmacist in the compounding of prescriptions. The greatest care, accuracy and skill, may be displayed in compounding a mixture, when, in a moment of absent-mindedness, an error may be committed in writing the directions on the label, or placing the wrong label on the package, or, what is worse still, by delivering medicine intended for an adult in place of that for an infant. All these points must be considered in the dispensing of prescriptions, and they call for constant vigilance on the part of the pharmacist. Upon the receipt of a prescription by him it should be registered as a sacred trust, that the health and perhaps the life of his patron is in his charge, and that this obligation is not discharged until he sees the little package, to which a fond mother's loving hope may be pinned, safely in the hands of the proper person. Greater responsibilities may exist in other professions or vocations, involving the care of a greater number of lives and property, as with those in charge of steam conveyances for transit, but errors or accident may there usually be avoided by attention to well-known rules, discipline, etc., or dependence chiefly upon mechanical means. But in dispensing prescriptions, skill, rules and regulations are of little avail unless accompanied with a free mind, a clear head and an acute perception of the apparently most trivial details. In this branch of pharmacy the price of safety is pre-eminently eternal vigilance!

A general plan of procedure in "filling" a prescription will be here outlined, with the belief that adherence to it will reduce the chances for error to a minimum, if not entirely exclude them.

In receiving the prescription.

(1) *Note carefully the person* who brings it, while he is politely requested to be seated.

(2) *Glance over the prescription*, or all of them if more than one, so as to determine, approximately, the length of time required to complete them.

(3) *Inquire* whether or not he desires to wait, to have it delivered, or to call for it.

(4) *Make a memorandum* accordingly, and in case it is to be delivered, or called for, note also the name and address, unless numbered checks are used.

In compounding.

(5) *Read the prescription closely and deliberately*, especially the inscription, making in the meanwhile a mental inventory whether or not all of the different articles are in stock, and in the quantities required. In case of doubt of any, determine by examining the container, *but leave it in its place until wanted.*

(6) *Procure the container* of proper size.

If a bottle, fit it with a long, soft cork, if necessary squeezed with a press until it admits being inserted one-half its length; the other half extending facilitates its extraction with the fingers. It is of course understood that the reprehensible practice of chewing the cork will not be tolerated

COMPOUNDING—(CONTINUED).

(7) *Procure all the implements* necessary for the operation, mortar, graduate, etc., and place them within convenient reach, having previously made sure that they are clean.

(8) *Procure the first article* desired for incorporation or solution, and weigh or measure it carefully.

If the inscription is correctly written upon the prescription, the *basis* or active constituents come first, and, if consisting of several, the most active ingredient is first taken, which it is in any event, as a rule. The desired quantity having been disposed of, the container is stoppered, the name on the label read deliberately, and then placed upon the desk to one side of the scale, the next article in order of *quantity, or compatibility,* is then procured ; the label first being carefully read, the required quantity is obtained, and the container disposed of in the same way as the first, being placed alongside of it. This process is continued until all the articles have been procured and the operation is finished. With very bulky preparations, it is sometimes inconvenient to place the containers on the counter, and may perhaps be dispensed with.

WHEN THE COMPOUND IS FINISHED.

(9) *Each ingredient and quantity* should be checked off by the dispenser on the prescription, from the containers left standing upon the counter.

These should then be *immediately* put back in their respective places. This operation may be accelerated by the aid of an assistant. But no move must be made by the dispenser with any other work until the package is labeled, in order that mistakes in labeling may be avoided.

(10) *Any additions and alterations* made in compounding, should be explicitly stated upon the prescription, so that, in case of renewal, the preparation shall be identical with that originally dispensed.

The *kind* and *quantity* of the various agents employed pharmaceutically, such as excipients for pill-masses, or emulsifying agents, are not infrequently ignored by the physician, who leaves their selection to the pharmacist. For pharmaceutical reasons it may be necessary to deviate from the formula, in the character or quantity of the solvent, or to make alterations in the vehicle, excipient or diluent, entailing no objections therapeutically. This must never be attempted, however, except when absolutely necessary, and then, when possible, only with the consent of the prescriber, and *should always be accompanied by the proper* memoranda affixed to the prescription.

(11) The *numbering* and *dating* of the prescription is next in order. Both should be written in a plain, bold handwriting.

To avoid duplication, or errors in numbering, various devices are employed, the most satisfactory being the "patent dating stamp." An inexpensive device may be constructed by writing consecutive numbers upon large strips of paper, one-half inch wide; by pasting these together a thousand or more numbers may be rolled upon a spool in a box, the numbered end extending through a slit in the side. When a prescription is to be numbered, a number is cut off the slip and copied on the prescription, or if gummed it may be attached to it, thus saving writing and insuring consecutive numbers, provided, of course, that the numbers on the slip have been written correctly, and also that this operation is always performed when a prescription is to be numbered.

(12) *Writing the label* should be done, as in all writing pertaining to pharmaceutical work, clearly and distinctly, without flourish or abbreviation.

The *numbers* should always be *written,* as well as given in numerals ; for example :

Two (2) teaspoonfuls every three (3) hours.

This lessens the chance for error by the patient.

The *name* should be appended whenever it can be learned.

The *date* must always be given, as through it a prescription can frequently be found when desired for repetition, when the number on the label has been effaced. In the absence of a generally accepted plan, the number of the month should be given in Roman, the date in Arabic; thus : vii. 4. '88.

The *physician's name* should always be written in full.

(13) *Labeling must be done immediately* upon the finishing of each mixture or compound, and as soon as the label is written.

When two or more prescriptions are received for compounding, each mixture should be so completed as to make it impossible to mistake it for another. This can only be done by affixing the label to each, before work is commenced on the next one. In case two liquids are prepared for internal and external use respectively, care must be observed that the labels are not interchanged on the bottles, since mixtures intended for external application usually possess dangerous properties when taken internally. The following strip labels should always be used when directed upon the prescription, and when therein omitted, though clearly indicated, should be employed with proper discretion :

For External Use. Shake Well Before Using.

The injunction, "for external use," to the public conveys the impression that the mixture must be used only outwardly on the body, and that it does not apply to eye washes, gargles, injections, etc. While this definition is incorrect, it is best to avoid confusion by the employment upon these of the label, "Not to be taken !"

These strip labels should be attached *above* the label proper, as they are then more conspicuous than when appearing below it. If more than one is used on the same bottle, they may be placed alternately, the most important occupying the most conspicuous position.

(14) *The wrapping of the package* should be neatly done, after which it may be either tied with twine, or, preferably, the ends fastened together with red sealing-wax ; black wax should never be used, owing to the superstition of some persons construing its employment as an evil omen.

This is also true in *sealing* the cork tops, which is now chiefly done with the gummed tops in various bright colors. *Capping* the bottle with a piece of glazed paper, is an exceedingly attractive manner of finishing the package, and is especially to be commended because of assuring the patient that the contents are intact, when procured through the aid of a messenger. This is a feature practiced generally on the Continent, and worthy of adoption here.

(15) *In delivering* the package, care must be observed that no mistake be made in the identity of the "medicine" or of the purchaser.

In case numbered checks are not used, the name should be ascertained by deliberate questioning. *Verbal instructions* should as far as possible be avoided, as these are liable to cause confusion, reliance being placed upon the instructions upon the label. On the other hand, any inquiries should be met with a clear explanation, that the customer may be perfectly satisfied.

Extemporaneous Compounding.—Incompatibility.

EXTEMPORANEOUS COMPOUNDING.

Compounding, or the combination of remedies, more commonly called the "mixing of medicines," is that division of dispensing which involves, besides mechanical skill, also the application of pharmaceutical knowledge.

The compounding of officinal preparations has been described under the different classes of these already treated; unofficinal preparations belonging to these classes are made by the same processes.

Many mixtures are compounded as needed—*extemporaneously*—and of these some are not even stable, or lack other characteristics, which render necessary especial methods for their preparation.

Mixture, in a pharmaceutical sense, is a term applied to any compound of different substances mixed or brought together mechanically. These may be either liquid or solid, and in the former is frequently a clear solution.

The official term, *mistura* (mixture), is also designed to indicate the class of preparations in the U. S. Pharmacopœia for the sake of distinguishing them from more definite compounds or solutions, as illustrated in the two very similar preparations: Mistura Potassii Citratis and Liquor Potassii Citratis.

By the employment of the term "mixture" here, will be meant compounds, or preparations, not officinal, or directed to be prepared extemporaneously. The greatest number of these are prescribed by physicians, and are therefore treated here in connection with the compounding of prescriptions.

Care should be observed that all mixtures, especially solutions, be made to appear as clear and inviting as possible.

Solutions of salts, or mixtures of liquids, should always be strained through a piece of unbleached muslin before they are dispensed, whenever the matter rejected is *inert*. As the appearance of a mixture frequently depends upon the method employed in its preparation, the principal points to be observed will be here presented.

In compounding *liquid mixtures*, the most active constituents or base, is diluted with the vehicle, or a portion of it, if this is in excess.

If containing a *solid*, solution should be effected either by first reducing it to a powder in a mortar and triturating it with the liquid, or, when necessary, by the application of heat to it, contained in a test-tube or capsule. The substance next in order of activity should then be added, but in such a manner as to avoid decomposition or change, if indicated by its character.

In compounding *solids*, the same general rule should be observed, except that the base must invariably be reduced first to a very fine powder. It should then be incorporated with a portion of the excipient, diluent or vehicle, according as it is to be a pill, powder or ointment, until a perfectly homogeneous mixture is obtained. It is then easily mixed with the remainder of the forming body, to which have been added other active constituents, if present, in case these should be incompatible.

The directions given for the preparation of Emulsions, Ointments, Pills, etc., in previous Lectures are typical of these classes, and should be followed in extemporaneous practice. In the following, only examples which are exceptions to the general methods, are given.

INCOMPATIBILITY.

When different substances are brought together in a mixture, be it liquid or solid with the result of undergoing a more or less complete change, they are said to be *incompatible*.

This does not apply to the chemical compounds, or even to some mixtures where the resulting change produces a new compound or compounds desired for use; as, for example, in the preparation of Liquor Ammonii Acetatis or Mistura Ferri comp. Aside from this consideration, substances of very decided incompatibility are often directed to be mixed *intentionally* with the object of forming a new compound or compounds, for special reasons.

It will thus be seen that the term incompatibility in the generally accepted pharmacal meaning, is not always clear, and not invariably indicative of impracticable, unsafe, or otherwise undesirable combinations. There are indeed few instances in which the cause of incompatibility in a mixture cannot be accounted for by well-known chemical principles, and with these could also be explained, were our knowledge sufficiently complete.

The *only really scientific method* of determining the incompatibility, or the contrary, of the ingredients of a mixture, is a correct knowledge of chemical laws, and their practical application in pharmacy.

For the purpose of practical work in pharmacy, and especially in that pertaining to prescriptions, a generalization may be attempted by bringing together the more important substances, often directed to be compounded.

Incompatibility may be distinguished as being either of the following:

(1) Chemical, or

(2) Pharmaceutical.

Chemical incompatibility is of the greatest importance, because the change is usually more decided between chemical compounds, than between preparations of vegetable drugs, the latter involving chiefly the solubility of their constituents, their mechanical suspension or other treatment.

The most common forms of chemical incompatibility occur under the following conditions:

(1) When the solutions of two salts are mixed, resulting in the formation of a new salt, which, being insoluble, precipitates.

R. Plumbi Acetatis.....gr. xx.
Zinci Sulphatis.....gr. xv.
Aquæ Rosæ.....fl. oz. iii.
M. et S. Shake well and use as an injection.

Here the prescriber desires to exhibit lead sulphate, in its freshly prepared state, and directs it to be formed by double decomposition between the two salts, lead acetate and zinc sulphate. The sulphuric acid radicle having greater attraction for the lead, leaves its own base and combines with the lead, forming lead sulphate, while the weak acid, acetic, being displaced, combines with the zinc, forming zinc acetate, which remains in solution. The lead sulphate being insoluble is precipitated as a dense, white powder, but upon shaking the mixture, it is temporarily suspended, hence the necessity of directing the bottle "to be shaken" when the contents are to be used.

Chemical Incompatibility.

A similar decomposition of two soluble salts may, however, under certain conditions not always be desired, or in fact, not suspected, as illustrated in the following:

℞ Quininæ Sulphatis. .....gr. xx.
Potassii Acetatis.... .....gr. xxx.
Acidi Sulphurici diluti .....m. x.
Aquæ.....f. ʒ iss.
Syrupi.....f. ʒ iv.

M. et S. One dessertspoonful every three (3) hours.

In compounding the above, the quinine sulphate is dissolved in a portion of the water, by the aid of the acid, and added to the potassium acetate, previously dissolved in the remainder of water, the syrup being added last.

Upon the two solutions being mixed, the acids exchange their bases, resulting in the formation of potassium sulphate and quinine acetate, the former remaining in solution, while the quinine salt, being almost insoluble, is suspended in the liquid. It is not precipitated, as is the case in the first example, owing to its bulk and light weight, but remains permanently suspended in the liquid, giving to the mixture a consistence which prevents it from being poured. Quinine sulphate being almost insoluble in water, its solution is effected by converting it into the much more soluble bisulphate by the addition of acid, but the latter also combines with the potassium and hence does not prevent the formation of the almost insoluble salt.

(2) With solutions of salts of weak, or volatile acids, by the addition of a strong acid, when decomposition results.

Several officinal preparations and other mixtures are prepared extemporaneously, by decomposing an alkaline carbonate with an acid, such as acetic, citric or tartaric acids. The solutions of ammonium acetate, magnesium citrate and sodium tartrate are good illustrations.

In these the carbonic acid of the respective carbonates, is easily displaced by the acids mentioned, and, being volatile, escapes, though a portion of it may be retained in the solution if kept in a closed vessel.

In these the decomposition is *intentional*, and since definite compounds in an eligible form are produced, the solutions can not be regarded as incompatible mixtures. But in the case of many pharmaceutical preparations containing acids, *i. e.*, vinegars, and especially when viscid, as, for example, the syrups of allium and squills, which are prepared from the vinegars; or of some fluid extracts, such as that of uva ursi the addition of an alkaline carbonate produces effervescence and sometimes explosion. Such mixtures should be prepared by adding the vehicle to the solution of salt in a mortar, under constant stirring. The thinner the liquid the more quickly will the gas escape, hence the solution should be diluted with as much water as is permissible.

(3) Salts of a feeble or volatile base are decomposed by the addition of a strong alkali.

Examples of this are rare; it may be illustrated in the evolution of ammonia, when a strong alkali is added to ammonia-alum.

(4) Alkaloids, by the addition of alkalies or alkaline salts, are thrown out of solution or precipitated from solutions of their more soluble salts.

Most alkaloids, morphine being a notable exception, are nearly insoluble in water, but their salts, such as the acetates, hydrochlorates and sulphates are comparatively soluble in water and other neutral or acid liquids. They are moreover very powerful medicinally, and hence administered in very small quantities, so that a salt, when of the faintest alkalinity, but prescribed in much greater proportion than the salt of an alkaloid, may abstract the acid from the alkaloidal base, with the result of throwing the almost insoluble base out of solution. Or what is more frequently the case, even if the alkaloid be soluble as a base in the liquid, the alkalinity of the mixture is sufficient to precipitate it.

It is a general rule that alkaloids are precipitated by alkalies. Illustrations may be mentioned of mixtures containing strychnine sulphate and potassium bromide, the latter in much the largest proportion, and similar preparations. The alkaloid and their salts are also incompatible with those chemical compounds with which they produce characteristic reactions.

(5) Iron and many of its compounds, upon the addition of tannic acid and preparations containing it, gallic acid, or other vegetable acids, produce a discoloration or precipitation.

This is a common form of incompatibility and is illustrated, when intentionally employed, in the preparation of ink, the discoloration of mixtures is also often termed "inky." Many examples might be given, but since nearly all vegetable drugs contain more or less of these acids, their preparations are often discolored, when mixed with iron compounds.

The *discoloration* may be *prevented* by employing certain iron preparations, or compounds of these with other salts, i. e., ammonium or sodium citrate. Especially is this the case with preparations of drugs not containing tannic or gallic acids, but some other vegetable acid, similar to these in being discolored by iron.

The most familiar illustration of this is the following formula for Elixir Gentian and Iron.

Take of Extract gentian fluid.....f ʒ ii.
Tinct. iron citrochloride.....f ʒ i.
Elixir, sufficient to make.....ʒ xvi.

Here the familiar discoloration of the gentisic acid with the tincture of iron chloride, is prevented by the use of a compound of iron as above indicated.

PHARMACEUTICAL INCOMPATIBILITY.

The production of more or less insoluble substances in mixtures of preparations of vegetable drugs, either associated or not with any chemical compounds, is termed pharmaceutical incompatibility.

It is of frequent occurrence; in many instances of no especial importance and though always undesirable, should not be prevented, if in conflict with the evident intent of the prescriber. In most cases, however, as, for example, in precipitation in liquid mixtures, incompatibility may be averted through the intervention of some indifferent media, or, in the case of solids, through attention to the order of adding the different substances together, or to the manner of mixing them.

The mixtures in which pharmaceutical incompatibility occurs may be divided into liquids and solids.

In *Liquid Mixtures*, incompatibility is most frequently due to a change in the vehicle or solvent, by the addition of one solution to another causing separation of inert, or active, constituents.

Illustrations of this are numerous, and, considering the vast number of liquid galenical, officinal and unofficinal, preparations employed, any specific directions for the prevention of separation are out of the question.

Pharmaceutical Incompatibility.

The following general rules may, however, be followed :

By dilution ; the greater the extent of dilution the less the danger from precipitation.

Preparations of drugs containing oils, resin or oleoresin, made with alcoholic menstrua, precipitate, or cause turbidity, when mixed with aqueous mixtures, or those containing only small proportions of alcohol. But by diluting a tincture, or a spirit of these, with less than its measure of diluted alcohol, it may often be added to watery solutions or mixtures, without producing precipitation if not turbidity.

By suspension ; the greater the density or viscosity of the liquid, the less the danger of change or precipitation.

With many mixtures, dilution can not be practiced ; in such cases recourse is had to suspension, by means of *intervention*, through some inert substance. The best general agent to serve this purpose is powdered *acacia*. Preparations of the class above described, resinous drugs, etc., can be mixed with watery solutions to which some acacia has previously been added, by trituration in a mortar ; care must be observed, that the percentage of alcohol in the finished mixture, be not so great as to precipitate the acacia.

Solubility must always be considered in all solutions or liquid mixtures. In simple solutions, the active constituents may be directed in larger quantity than soluble in the liquid.

If a salt, for example, potassium chlorate, it should be added in the form of powder and the mixture directed to be shaken while being used. It may be a liquid and differ in specific gravity from the vehicle, in which case the excess will either float upon the latter, as with a mixture of carbolic acid and water, or of chloroform and water, remain in a stratum at the bottom. In either case, most serious consequences may result.

It may be more complicated, and a powerful, or, as in the following case, an exceedingly poisonous remedy may be extracted from the mixture by the separated liquid, because of being easily soluble in the latter :

℞ Tincturæ nucis vomicæ..... f ʒ ii.
Chloroformi..... f ʒ ii.
Aquæ.....q. s. f ℥ iv.
M. et S. ——— .

Upon standing, this mixture separates, the chloroform sinking to the bottom, carrying a portion of the active principles of the nux vomica with it. The last dose may contain a poisonous quantity, and great caution must be observed in compounding prescriptions of this class.

With Solids, when different substances are acted upon when mixed, *dilution* often prevents undesirable changes.

In preparing ointments, pills and suppositories, care should be observed that active medicinal substances, when of such character, are each diluted with the vehicle, or excipient, before they be mixed together. Tannic acid is often directed to be prepared in ointment, or suppository, with opium, or extract of belladonna, with both of which it forms an insoluble compound. But when each active constituent is first incorporated with a portion of the vehicle, lard or oil theobroma, no change takes place when mixed, and a smooth and active preparation is easily produced.

Incompatibility may sometimes be both *chemical* and *pharmaceutical.*

Illustrations of this are frequently found in mixtures containing quinine, associated with some chemical compound, or acid, and a vehicle ; which is decomposed by the latter, as in following :

℞ Quininæ Sulphatis..... ʒ i.
Ammonii Chloridi..... ʒ iss.
Elix. Glycyrrhizæ arom.... ℥ vi.
M. et S. ———

Here a reaction takes place between the two salts, with the effect of throwing the active principle of the glycyrrhiza, glycyrrhizin, out of solution. The same change occurs when diluted sulphuric acid is used, and a clear mixture can only be obtained by leaving out the liquorice. Quinine can be eligibly exhibited, in liquid, only in two forms, either suspended in a viscid liquid, such as syrup of glycyrrhiza, or, in solution, by the aid of acids ; a compromise between these, when in large doses at least, is rarely desirable.

In the following list, the substances, which can not be classed as incompatible under any of the above divisions, are given for reference :

Substance.	Incompatible with
Acacia.....	Alcohol, alcoholic and ethereal tinctures ;* Borax ; Iron, chloride ; Lead salts.
Acids, in general.	Alkalies, Alkaline solutions ; Metallic Oxides.
Acid Arsenious...	Iron, oxide ; Magnesia ; Lime water.
Salicylic	Iron compounds ; Potassium iodide ;* Lime water.
Tannic.....	Alkalies, carbonates and bicarbonates ; Lime water ; Chlorine water ; Albumen ; Gelatin.
Bismuth Subnitrate...	Calomel ; Sulphur ; Tannin.
Chloral Hydrate.....	Alkalies, carbonates ;* Ammonium and Mercury compounds ; Potassium bromide and Alcohol.
Iodine	Ammonia ;* Alkalies, carbonates ; Chloral ; Metallic salts ; Starch.*
Lead Acetate.....	Acacia ; Acid Hydrochlor ; Acid Sulphuric and sulphates ; Ammon. chloride ; Carbonates ; Lime water ; Iodine ; Potassium iodide ; Tannin.
Mercury Bichloride ..	Potassium iodide ;* Salts, carbonates ; Tannin.
Mild Chloride (Calomel)..	Acids, acid salts ; Alkalies, carbonates ; Ammon. chloride ; Iodine ; Potassium iodide ; Iron chloride, iodide ; Sulphur.
Potassium Chlorate.....	Acids, mineral ; Calomel ; Organic substances ; Sulphur.
Iodide.....	Acids, acid salts ; Alkaloids ; Iron ; Lead and Mercury salts ; Potassium chlorate ; Silver nitrate ; Chlorine water.
Permanganate	Ammonia, salts ; Alcohol ; Glycerin ; Ethereal oils ; Organic substances.
Sodium Bicarbonate .	Acids, acid salts ; Acid Tannic ; Alkaloids ; Metallic salts.
Bromide	Acids, mineral ; Chlorine water ; Mercury compounds.
Silver Nitrate.....	Acids, Acetic, Hydrochloric, Hydrocyanic, Sulphuric, Tartaric, and their salts ; Alkalies, Carbonates ; Iodine ; Potass. iodide, bromide ; Sulphur.

Those marked with an *, are sometimes directed to be compounded.

Questions on Lecture X.---Series 8.

1. What is the composition of Potassa, U. S.?
2. Why is the *strength* of Liquor Potassa not stated definitely in the U. S. P.?
3. How is Potassium Bicarbonate prepared? Explain the *reaction* that occurs.
4. Mention some of the uses for Potassium Bichromate.
5. What occurs when Potassium Acetate is strongly heated?
6. Why is it difficult to obtain this salt in the pure crystalline form?
7. What is the composition of Fowler's Solution?
8. State the relative difference between the Cyanide and Ferrocyanide of Potassium as regards toxicity.
9. Mention two *common physical properties* that characterize Sodium Compounds by which they may be *distinguished* from Potassium Compounds.
10. What officinal preparations contain Potassium Citrate?
11. What officinal Powder contains Magnesia?
12. What is Lime chemically?
13. Describe the *change* that occurs in the preparation of Calcii Carbonas Præcipitatus.
14. What officinal preparations contain Calcium Hypophosphite?
15. What is Chili Saltpetre?
16. What is the chemical *composition* of Aluminium Hydrate? How prepared?
17. What is its chief use in pharmacy?
18. What is the difference in manufacture between Light and Heavy Magnesia?
19. How could you *prove the absence* of Ferrous Iron in Solution Chloride of Iron?
20. What is the difference, *chemically* and *physically*, between Ferri Sulphas and Ferri Sulphas Præcipitatus?
21. What is the composition of Solution of Subacetate of Lead?
22. What precaution must be observed in dispensing Silver Nitrate?
23. What two *Classes* of Compounds does *Mercury* form? Mention the Officinal members of *each* Class.
24. By what *physical properties* may *Calomel* be *distinguished* from Corrosive Sublimate?
25. Give the chemical *composition* of Tartar Emetic, and of what largely used "domestic remedy" is it an *ingredient?*

IMPORTANT.

Students will please reply to the above questions on *letter-size* paper (not note), *in ink*, as briefly as possible and without copying the lecture. Write plainly, on *one* side of the paper only (which must be signed, or no notice can be taken of it), and forward promptly to the Director. In answering it is *not* necessary to repeat the question itself, but only the *number* of each question.

☞ Write a copy of your answers and preserve it for future use.

Metrology.

The study of pharmacy embraces the sciences of Botany, Chemistry and Physics. The Term in Pharmacy, generally treated as a separate branch in schools and in these Lectures, is based primarily upon physics and chemistry.

Of these two sciences it may be said that physics is the basis of the practice of pharmacy, because it governs all the processes and operations in the practice of the art.

The practice of pharmacy in a general sense was treated in the first three Lectures under the respective heads of Metrology, Heat and Solution.

By Metrology is meant here the measurement of substances, and embraces the two general subjects, Weights and Measures; and Specific Gravity or Weight and Volume; also the measurement of heat—Thermometers.

All values are expressed by some standard of comparison; that upon which our weights and measures are based being extension or *linear* measurement obtained primarily from the length of the second's pendulum, or, as in the Metric system, from the earth's meridian. From this are then obtained the actual standards or *units*, viz.: the English and American units, from the weight of one cubic inch of pure water (62° F.) declared to be 252.458 grains, 7,000 of such grains being equivalent to one Avoirdupois pound, and 5,760 to one pound Troy.

The three different systems of weights, troy, avoirdupois, and decimal or metric, have been described, their differences pointed out, and similarities, when existing, explained.

It was shown that the *grain* is the *unit* for the avoirdupois and troy, and that, while there are 12 troy ounces in a troy pound, and 16 ounces in an avoirdupois pound, comparing as 3 to 4, the difference is not really one-fourth, because the troy ounce contains 480 grains as against 437½ grains in the avoirdupois, making the troy pound 5,760 grains to 7,000 grains in the avoirdupois.

In measures for Liquids the same difficulty in comparison appears as in our weights, because the systems are not parallel.

Thus a pint is not a pound, notwithstanding the old saying, but 7,300 grains; a fluid ounce is neither an avoirdupois nor troy ounce, but an intermediate quantity, namely, 456¼ grains, and a minim is not a grain, but $\frac{95}{100}$ grain.

The Metric System is also based upon extension, the Meter being the forty-millionth part of the length of the circumference of the earth, or the ten-millionth part of one-quarter of its meridian, or the quadrant.

The cube of one-tenth of the meter is the measure of capacity, the *Liter*, and the standard weight unit is the weight of its one-thousandth part of water, or *the cube of one-hundreth part of the meter* (cubic centimeter), termed *Gram*, or gramme.

One Gram is equal to 15.432 grains, and 4 Grams are usually taken to be equivalent to one drachm.

While all our present systems are based primarily upon the measure of extension, they are indirectly obtained from the weight of a certain volume of water.

Water is, therefore, the first substance used as a standard for determining weight. It is also used as a standard for *comparing* the *relative weight of other liquids.*

The difference in weight in many liquids is singular, in that no two simple liquids have the same weights, that is, *equally heavy.*

This refers, of course, only to liquids dissimilar in chemical composition, and not to those closely allied to each other. The comparative weight of liquids, therefore, discloses their identity.

This comparative weight has been termed *specific gravity*, though it might be more correctly termed specific weight. (See Lecture I, subj., Weight).

Water being the standard for comparison or *unit*, is taken as 1, and the *weight* of the *same bulk* of any *other liquid* is expressed in decimal proportion to 1.

Thus, if a bottle which holds 500 grains of distilled water is found to hold 625 grains of glycerin at the same temperature, we bring the standard for comparison, water, to a decimal unit 1,000 by multiplying by 2. The weight of the glycerin multiplied by 2 gives 1,250, which number compared to 1,000 is as 1.25 to 1.; hence 1.25 is the specific gravity of the glycerin. Of alcohol, this same bottle holds only 410 grains; the specific gravity of the alcohol is therefore: 410×2=820 or .820. But this is only true at a temperature of 60° F.; at a higher temperature the alcohol expands and the same volume weighs less, while at a lower temperature the alcohol contracts, and an equal volume weighs more. This is true, to a greater or less extent, with nearly all liquids, and the comparison must, therefore, always be made at one temperature, 59° Fahr. (15 C.), being that chiefly employed. By reversing this process of calculation we obtain the measure of liquid proportions or their *specific volume.*

Owing to the fact that the formulas in the U. S. P. are based upon parts by weight, the quantity of products and the proportion of the other constituents are readily seen by *weight*, but for practical purposes it is necessary to know them by *measure.* By first obtaining the weight of a measure of the liquid, we can easily compute the percentage strength of the ingredients.

Here again water is the standard, the weight of one pint, 7,300 (7,292) grains, being the basis for comparison, because of its convenient quantity.

The specific gravity of the preparation, if an official solution, may be obtained in the Pharmacopœia, or may be determined approximately, as in the case of tinctures, etc., from the specific gravity of the menstrua. The specific gravity, obtained by comparison with water at 1., is now multiplied by the water, not as a unit (1.), but as the standard quantity of one pint, 7,300 grains. For example: Solution chloride of iron has the sp. gr. 1.405; this multiplied by 7,300 gives 10,256 grains, the weight of one pint. If it contains 37.8 per cent. of anhydrous chloride of iron, how much then in one fluid ounce? One fluid ounce weighs 641 grains; then 641×37.8=242.29 grains chloride of iron.

Tinctures prepared with alcohol (0.820) may be approximated thus: 7,300×.820=5,986 grains in one pint. This is not absolutely correct, because the extractive obtained from the drug increases the weight of the tincture over that of the menstruum; but, by taking the weight of one pint in round numbers at 6,000 grains, the variation will not exceed, in the most extreme cases, five per cent., and therefore answers practically all purposes. The weight of one pint of the preparation obtained, the quantity of drug to the pint, fl. ounce, or fl. drachm, is easily determined. For example: In a tincture 10 per cent. (by weight), 6,000×.10=600 grains of drug; tinctures 15 per cent., 6,000×.15=900 grains of drug; 20 per cent., 6,000×.20=1,200 grains of drug, and so on.

Heat.—Solution.

Heat may be latent or sensible. Latent heat is present in all bodies, and becomes *sensible*—that is, it may be determined physically by the rise of temperature, as shown in the condensation of steam. *Sensible* heat on the other hand is rendered *latent* by the conversion of water into steam, or as illustrated by the cold produced by the evaporation of a few drops of ether from the hand, the change of aggregation from a liquid to a gas requiring the abstraction of heat from the hand, which heat becomes latent.

The principal uses of heat in pharmacy were stated to be for boiling, evaporation and fusion.

Boiling is convection carried to its limits, and the temperature thus obtained is termed the *boiling point.*

Water boils at 212° F., and it is taken as a standard for the instruments for measuring the temperature, viz.: Thermometers. Of these in Celsi the boiling point of water is 100°, and in Reaumur 80°. With other liquids the temperature at which this limit is reached varies to such an extent that they may often be identified by the boiling point, hence the importance of its determination. When this limit is reached the temperature under ordinary circumstances is not raised, and if the heat be continued the excess is spent in changing the liquid into gas or vapor, and *evaporation* takes place—the heat becoming latent.

When the vapor comes in contact with cold its latent heat is abstracted, and it is reduced to its former state, a liquid, or *condensed.* These two physical phenomena, evaporation and condensation, when used in pharmacy as a process for separating liquids of different boiling points, or for obtaining volatile principles, is termed *distillation.*

By the same process the evaporation of the moisture of the earth is returned to us as rain; hence the similarity between rain-water and distilled water. When applied to solids, volatizable at not too high a temperature, it is termed *sublimation.*

When distillation is desired the liquid is brought to boiling so as to expedite the process, because the vaporization is then greater, and the process itself excludes its application to substances injured by the temperature required, but evaporation is also employed with substances where a high temperature must obviously be avoided.

Most liquids vaporize at temperatures much *below* their boiling point, the process being slow at ordinary conditions, but quite rapid when exposed to constantly changing air, which becomes charged with the vapor.

Evaporation may, therefore, be effected at any temperature, provided the air is renewed frequently; hence the use of shallow vessels and constant agitation. To expedite the process, however, the temperature should be brought to such a height as the character of the substances may warrant, or circumstances permit. Heat may also have chemical effects when applied to solids; these are either a chemical *union*, as in oxidation or chemical *decomposition* (as in reduction or de-oxidation), calcination the opposite of sublimation, and incineration or its much milder form, torrification, by which certain constituents of vegetable drugs are changed without impairing their more active principles.

Solution is the result of the molecular attraction of liquids for solid substances, and is facilitated by weakening the cohesion of the molecules by heating the liquid, or by the mechanical division of solid substances. Thus all solids are more readily soluble when in the powder than when whole, and the solvent powder of liquids is increased when their temperature is heightened.

There are many exceptions to this, however, as when a solid is readily soluble; gum acacia, for example, dissolves in water so rapidly that a viscid solution is formed surrounding its particles, which prevents the admission of fresh solvent. Substances of this character, *i. e.*, gums, sugar, etc., should therefore not be powdered in making solution. There are a few substances whose solubility is not increased by heat, but, as a rule, the temperature of the solvent governs the amount of the substance dissolved, and it must therefore be carefully considered.

Solubility of solids, similarly to the boiling point of liquids, varies greatly, not alone among different solids, but also as to different liquids. It is one of the principal methods of determining the identity and purity of many chemical compounds in the U. S. Pharmacopœia in which their solubilities are given in a table, namely, the number of parts of water required for the solution of one part of the substance at 59° F. (15° C.) When a greater quantity of the substance is dissolved in a liquid by increasing its temperature, though soluble in the same liquid at ordinary temperature, the solid, if originally a crystalline substance, will deposit upon the cooling of the liquid, assuming regular forms—*crystallizes.*

Crystallization may also be effected by the evaporation of the solvent, and large and small crystals be obtained, as this is slow or fast; by fusion and sublimation, and also by chemical reaction in solution, or precipitation.

Precipitation is a different process, however, which consists in obtaining an insoluble compound from solutions of soluble compounds, the product being termed a *precipitate.*

When this precipitate is not very dense, but gelatinous—a magma—it is usually freed from the soluble compound or compounds remaining in solution by washing it with successive portions of water, each portion of liquid upon the subsidence of the solid particles being displaced by a fresh portion—this is called *decantation.*

When the precipitate is so fine that it remains suspended in the liquid so as to give the latter a cloudy appearance, the liquid is passed through some media which arrests the undissolved particles and permits the liquid to escape clear; this is the process of *filtration*, and the clear liquid is termed the filtrate. When applied to remove grosser impurities it is termed *straining.*

These are purely mechanical operations, but, when the removal of insoluble substances cannot easily be effected by such means, *chemical* substances are added, which combine, forming still less insoluble compounds more quickly precipitated—this is termed *clarification.* To free solutions of vegetable principles from color, as in the preparation of alkaloids, neutral principles, sugar, etc., filtration through some absorbent substance; for example, animal charcoal is resorted to, and the process is termed *decoloration.*

Extraction.—Pharm. Preparations.

Diffusion of liquids does not differ much from solution, some liquids commingling freely with each other, others sparingly or not at all, just as regards the solubility of solids. Diffusion, however, is much more rapid, and takes place even through a membrane, if the liquid be of a character to wet it thoroughly (water), and so placed that capillary attraction is established.

This phenomenon of molecular attraction is termed *osmosis*, and only crystalline substances in solution can be diffused. This process is, therefore, used in pharmacy under the term dialysis, to separate *crystalline* active principles in solution from those of *amorphous* character—non-dialysable.

In the extraction of vegetable drugs, solution is effected by the diffusion of the soluble constituents through a liquid or menstruum.

With all cellular drugs, such as roots, barks, leaves, etc., it is also accompanied, to some extent, by osmosis through the cell-walls, but since in the extraction *all* the soluble matter is desired, and not alone the crystalloids obtained by osmosis, it is necessary to weaken the cohesion of the parts by reducing them to *powder*, so that a greater surface is presented to the action of the solvent.

The degree of fineness of the powder, as indicated by the number of sieve, varies with the solvent employed.

With *water* as a solvent, as in infusions and decoctions, the drug should be in a very *coarse* powder, because the extraction here is effected in the first instance chiefly by osmosis, and in the second by heat, and also by the quantity of solvent employed.

With *aqueous* menstrum the substance should be in a moderately coarse powder partly for the same reason, and also because amorphous substances, such as starch, gum, etc., not desirable medicinally, may not be easily dissolved, but retained by the osmotic currents.

With *alcohol* or alcoholic menstrua the substance should be in a *fine*, or very fine, powder, so fine that the cell-walls may, if possible, be ruptured. Here the osmosis does not take place, owing to the absence of water necessary to its action, and the greatest surface must be presented to the solvent action of the alcohol, which alone effects solution. There are intermediate stages to these conditions, but as a rule the above may be regarded as correct.

The simplest form of extraction is *maceration* with expression; it is most applicable to preparations wherein greater quantities of solvent are employed. With more concentrated preparations, such as tinctures, and more especially fluid extracts, extraction is effected by *percolation*.

Percolation, when skillfully performed, exhausts the drug quite as completely as when larger quantities of solvents are employed, necessary in maceration. The most important points to be observed in percolation are. Appropriate apparatus, proper fineness of the drug, careful packing, and the use of proper menstrua.

When the formulas and processes are given in the U. S. P., the preparations are said to be pharmaceutical or pharmacopœial.

The organic compounds, *i. e.*, acids, alcohols, sugars, oils, etc., may, however, be classed also in this category, although their preparation is not directed in the Pharmacopœia. But, inasmuch as the process for their production are primarily pharmaceutical, namely, either that of extraction or distillation, or both of these combined, they may be termed pharmaceutical, though not pharmacopœial.

The pharmacopœial preparations were divided into three classes: Solutions and Mixtures, Products by Extraction, and Mixtures of Solids.

The arrangement seems to be the most simple, because it is based upon the processes involved, therefore bringing preparations made by nearly the same method under one head, and thus facilitating their study and comparison. To render the subject still more easy of comprehension and remembrance, each of these divisions is again divided into the respective *classes* of preparations, commencing with those most simple.

Solutions were divided, according as the solvents employed were water, alcohol, etc., each embracing one or more distinct pharmacopœial classes:

		Number of preparations officinal.
Aqueous	Pure waters	2
	Chemical waters	3
	Medicated waters	10
	Infusions	5
	Decoctions	2
	Liquors	26
	Mucilages	5
Alcohol	Natural Spirits	2
	Aromatic Spirits	18
	Chemical Spirits	2
Acid	Solutions of Oleates in oleic acid	2
Vinous	Natural Wines	3
	Medicated Wines	11
Saccharine	Syrup (simple)	1
	Syrups, by solution	11
	Syrups, by extraction	14
	Chemical Syrups	8
	Honeys	2
Glycerites	Semi-liquid Solutions in Glycerin	2

Mixtures comprise the liquid preparations, which, owing to their complicated composition, cannot be included in a better classification, viz.:

(1). Elixirs; only one is officinal.
(2). Mixtures; the officinal class, 11 preparations.
(3). Liniments; liquids for external use, 11 preparations.

Products by *extraction* comprised the largest number of preparation, and the two most important classes of pharmaceutical preparations, viz.: Tinctures and fluid extracts. These were divided, according to the solvent and the order of their strength as related to the crude drug from which they are obtained, as follows:

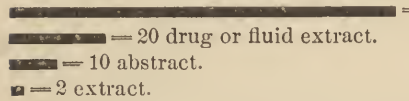
1. *Infusions* and *Decoctions* belong to products by extraction, but, according to the solvent employed, were classified with aqueous solutions. Medicated Wines prepared by extraction are similarly classified, together with those prepared by simple solution.

2. *Vinegars.*—The officinal class embraces four preparations, all of the uniform strength of *10 per cent. by weight.*

3. *Tinctures* were, of alcoholic preparations, considered first, because of being simple products of extraction, and therefore weaker in strength than the remaining classes, in the preparation of which some process of concentration is employed. A tincture is the mother-product from which all other extractive preparations are indirectly obtained.

Pharmacopœial Preparations.

The following illustration shows the corresponding relation between the different preparations of nux vomica, each representing 20 parts of the drug :



The tinctures have the following strengths :

No. of Prep. Officinal.		Per Cent. of Drug.	No. of Prep. Officinal.		Per Cent. of Drug.
2—	Containing	5	22—	Containing	20
1—	"	8	1—	"	40
20—	"	10	1—	"	50
10—	"	15	16—	Compound tinctures	

4. *Fluid Extracts* were divided into six different classes, according to the special process employed in their preparation, as follows :

Process A, embracing by far the largest number, viz., 71, of the officinal fluid extracts.

It consists simply in exhausting the drug by percolation, reserving the most concentrated portion of the percolate, and then, by evaporation, concentrate the weak percolate, adding it to the reserve, either first dissolved in a portion of the menstruum or with an addition sufficient to bring the product to the proper measure. This is the process upon which the others are based and modified, according as the drug may be difficult to exhaust, or so as to obtain a product pharmaceutically better.

Process B, addition of acid to prevent change of the active constituents ; only two are officinal.

Process C, addition of acid in the extraction of aconite ; alkali in that of glycyrrhiza, these two being officinal.

Process D, to prevent precipitation or gelatinization—by the addition of an alkali in the extraction of senega, the only one officinal.

Process E, the rejection of inert matter in ipecac and lactucarium to insure a clear mixture with syrup.

Process F, exhaustion by infusion, concentration, by evaporation and precipitation of inert constituents by the addition of alcohol. Only two fluid extracts, prepared by this process, are officinal, viz. : castanea and triticum.

5. *Abstracts.*—By the evaporation of a fluid extract to a semi-liquid, and addition of milk sugar in such quantity that the weight of the mixture, when dried and powdered, equals one-half the amount of the crude drug employed, we obtain an abstract.

To facilitate evaporation, however, the solvent employed is usually different from the menstrua used for the preparation of fluid extracts from the same drugs ; these also sometimes contain glycerin, hence in the preparation of the abstracts the officinal directions must be followed throughout, instead of starting with the fluid extract.

The abstracts represent uniformly twice the strength of the crude drug, the dose being therefore one-half that of the drug or the fluid extract. They are also more uniform than the extracts, because not sharing the variation in regard to yield, and more definite than the powdered extracts, which they are intended to replace. There are eleven abstracts officinal, those of jalap and valerian replacing the extracts of these drugs formerly officinal.

6. *Extracts.*—By continuing the evaporation of the extractive matter until a soft solid of pilular consistence remains, an extract is obtained.

The percentage quantity compared with the crude drug indicates *the strength* of the extract, and hence its dose. This yield is largely influenced by the character of the solvent used in the extraction, hence the necessity for the employment of official menstrua in the preparation of the extracts. Of this class thirty-one are officinal, one being a compound and in the powdered form.

7. *Resins.*—By pouring the concentrated alcoholic tincture of a resinous drug into cold water, the resin precipitates, and when carefully dried constitutes a resin.

It is really a pharmaceutical resin in distinction to a natural resin. If the active or medicinally valuable constituents of the drug are entirely *resinous,* the preparation represents the drug in a very convenient and concentrated form. Of the vast number of drugs, however, only three are officinal in this form.

8. *Oleoresins.*—Preparations obtained by extraction of drugs with ether and evaporation of the solvents, constituting a class termed oleoresins, of which six are officinal.

These are semi-liquid, and contain chiefly the constituents soluble in ether, viz. : Fixed and volatile oils and resins.

Mixtures of solids, owing to their compound character, are divided into those for *internal* use, and those for *external* medication.

While this arrangement is not a scientific one, it is nevertheless very appropriate, because the *use* of the remedies governs the *form* of the different preparations, and these are thus brought together in their respective classes for study and comparison.

Those for *internal use* were arranged upon the progressive plan, commencing with the most simple form, as follows :

		Number of preparations officinal.
Powders	Simple powders, opii pulvis	1
	Compound powders	9
	Triturations	1
Masses	By the incorporation of adhesive, semi-liquid substances to obtain a plastic consistence	3
Confections	Masses in which the excipient is sugar in large proportion	2
Troches	Confections, flavored, made in various forms and dried	15
Pills	Masses divided into spherical form not exceeding five grains	14

Preparations for External Medication are all more or less oleaginous, and the vehicle employed governs their consistence ; they were grouped accordingly, those most *unctuous* coming first, and then in sequence until the last class. The preparations of this last class are brittle at ordinary temperature, but when used are rendered adhesive by the warmth of the body. The following are officinal :

		Number of preparations officinal.
Ointments	By simple admixture	18
	By fusion	5
	By chemical reaction	2
Cerates	By admixture or fusion	6
	By maceration and fusion	2
Suppositories	Cerates formed into cones weighing 15 grains, the vehicle being cacao oil ; none officinal.	
Plasters	Simple plasters	5
	Compound	12

Of compound plasters, lead plaster is the vehicle in seven, resin plaster in the remaining five

The Organic Compounds.

THE ORGANIC ACIDS.

The organic acids are compounds, analogous in properties and also in chemical structure to inorganic acids, but differing in the fact that the negative radical is complex and has a carbon nucleus.

These acids are very numerous, constitute several series, each member of the same series differing from the next higher in having lower fusing and vaporing points, and a lower specific gravity.

Those of most importance in pharmacy are :

Acetic Acid, obtained from dilute alcoholic solutions, acetates, wood, and saccharine solutions.

Benzoic Acid, from benzoin, coal-tar products, etc.

Carbolic Acid, from coal-tar.

Gallic Acid, from nut-galls.

Tannic Acid, from nut-galls and oak bark.

Citric Acid, from lemons and limes.

Lactic Acid, from sour milk.

Oleic Acid, from fats.

Oxalic Acids, from sugar and nitric acid.

Salicylic Acid, prepared from carbolic acid.

Tartaric Acid, prepared from cream of tartar.

THE ALCOHOLS.

The alcohols are hydrates of more or less complex carbo-hydrogen radicals.

They form several distinct series, the monohydrates, the dihydrates, trihydrates, etc., according as they are built on the plan of one or more water molecules.

To the monohydrates belong :

Methyl alcohol, or wood spirit, obtained by the destructive distillation of wood.

Ethyl, or common alcohol, obtained by the fractional distillation of fermented saccharine solutions.

Amyl alcohol, or fusel oil, as a by-production in the process of manufacturing ordinary alcohol.

The dihydrates are of little pharmaceutical importance.

The trihydrates are illustrated by :

Glycerin, obtained as a by-product in the manufacture of soap, lead-plaster, and by the decomposition of fats by means of heat in the presence of water.

Nitro-glycerin, obtained by pouring glycerin, drop by drop, into a cooled mixture of sulphuric and nitric acids, is an ethereal salt of glycerin.

There are no tetrahydrates of importance.

The hexahydrate alcohols are represented by :

Mannitol or mannite, a sweet substance obtained from the manna, Fraxinus ornus, and other mannas.

THE ETHERS.

The ethers are products of the action of acids on alcohols. There are several distinct series as of alcohols. They bear the same chemical relation to alcohols that metallic oxides do to metallic hydrates. Some are liquid, highly volatile and inflammable, others dense, non-volatile. or solid at ordinary temperatures.

The chief groups of ethers are :

1. Simple ethers, including such as methyl and ethyl ethers.

2. Haloid ethers, including such as ethyl chloride, ethyl bromide, ethyl iodide, etc.

3. Compound ethers, such as acetic, formic and nitrous ethers.

The most important ethers are the following :

Ethyl, or Sulphuric ether.	From distillation of ordinary alcohol with sulphuric acid.
Ethyl Chloride, or Chlorhydric ether	By the action of phosphorus pentachloride on ordinary alcohol.
Ethyl Bromide, or Bromhydric ether	By the reaction of bromine on alcohol in the presence of phosphorus.
Ethyl Iodide, or Iodohydric ether.	(Prepared by an analogous process).
Ethel Acetate, or Acetic ether.	By distillation of a mixture of sodium acetate, alcohol and sulphuric acid.
Ethyl Nitrite, or Nitrous ether.	By distillation of a mixture of sulphurid acid, nitric acid, alcohol and water.

COMPOUNDS RELATED TO THE ALCOHOLS AND ETHERS.

The most important pharmaceutically are :

Chloroform, usually made by distilling strong alcohol with bleaching powder and water, and

Chloral, prepared by passing dry chlorine gas into absolute alcohol.

THE CARBOHYDRATES.

The carbohydrates include starches, sugars, cellulose, lignin and gums. In chemical structure they agree in being composed of carbon, oxygen and hydrogen, and the last two, O and H, *in the same proportion in which they exist in water* (H_2O).

Starch is an assimilative product, produced by the agency of chlorophyll in the green part of plants. It is widely distributed through the vegetable kingdom, occurring in the form of small granules in the cells of plants.

The dextrins, lichenin, inulin and glycogen are closely related bodies.

Sugars differ from starches in being crystalline, sweet or sweetish to the taste, and soluble in cold water. They are divided into *Saccharoses* and *Glucoses.*

Saccharoses include *cane, milk, maltose, melitose* and some other sugars. They have the formula $C_{12}H_{22}O_{11}$, and are not directly fermentable.

Glucoses include dextrin or grape sugar, levulose or fruit sugar, inosite or muscle sugar, and several others ; have the formula $C_6H_{12}O_6$, and are directly fermentable.

Cellulose is the important constituent of the cell-walls of plants, has the same chemical composition as starch ($C_6H_{10}O_5$).

Cotton fiber treated with a solution of caustic potash to remove oily matters, and afterward thoroughly cleaned and dried, is nearly pure cellulose.

Lignin is a modification of cellulose found in the thickened cell-walls of plants. Old wood usually contains it in large proportion.

Gums are mostly vegetable products, apparently formed by the transformation of cellulose, and resembling it chemically. The most important are :

Gum Acacia, or Gum Arabic, derived from Acacia Verek and other species of Acacia, and

Gum Tragacanth, obtained from various species of Astragalus.

Derivatives of Organic Drugs.

ESSENTIAL OILS.

These resemble the fixed oils in appearance and in many of their properties, but differ in chemical structure, in not being saponified by alkalies, in being more or less volatile at ordinary temperature, and in being completely volatilized by heat without undergoing chemical change.

They occur widely distributed through both the animal and vegetable kingdoms. Most that are of pharmaceutical importance are from plants.

They are obtained by *expression*, by *distillation* with water, by aid of a *volatile solvent*, and by the process of *enfleurage*.

They may be classified into:

Hydrocarbons, as oil of turpentine $C_{10}H_{16}$.

Oxygenated essences, that contain, beside carbon and hydrogen, a little oxygen, as oil of anise.

Nitrogenated essences, those which contain hydrocyanic acid, as oil of bitter almonds.

Sulphurated essences, which, like oil of mustard, contain sulphur.

Empyreumatic volatile oils, which are obtained by destructive distillation of organic bodies, as in the case of the petroleums; occur as minerals.

The Camphors are solid bodies of vegetable origin, closely allied to volatile oils, and, in some cases at least, derived from them by oxidation.

RESINS.

Resins are solid, usually amorphous vegetable products, commonly with a conchoidal fracture, soluble in alcohol, usually soluble in fixed oils, insoluble in water, usually transparent or semi-transparent, readily fusible, burning with a sooty flame, not volatilizing without chemical change, and negatively electrified by friction. Some contain acids which unite with alkalies to form soaps; others cannot be saponified. Contain carbon, oxygen and hydrogen. The most important natural resins are:

Guaiac.....From the heartwood of Guaiacum officinalis and G. sanctum.
Copaiva.....From different species of Copaiferæ.
Mastich.....From Pistacia Lentiscus.
Elaterium....From Ecbalium Elaterium.
Copal.....A fosil resin from Africa.
Dammar.....From different coniferous trees, Dammara Orientalis, D. Australis.
Sandarac.....From Callitris quadrivalvis.
Colophony (Rosin)...Residue from the distillation of oil of turpentine.
Lac (shellac)..From several East Indian and a few Mexican plants.
Amber.....A fossil resin from the Baltic.
Asphalt.....A fossil resin belonging to the petroleum series.

Oleoresins are mainly of vegetable origin, and consist of mixtures of resins and volatile oils. They are distinguished from resins by the odor given off when heated. The most important natural oleoresins are:

Copaiva.....From same source as copaiva resin.
Gurjun.....From Dipterocarpus turbinatus and other species of the same genus.

Turpentines are oleoresins, which, with the exception of Cyprus turpentine, are derived from coniferous trees. Their volatile oils have the same chemical structure as common oil of turpentine.

BALSAMS.

The balsams are liquid, semi-liquid, or solid vegetable products, containing in addition to a resin or oleoresin, benzoic or cinnamic acids, or both. The most important are:

Tolu.....From Myroxylon Toluifera.
Peru.....From Myroxylon Pereiræ.
Styrax.....From Liquidamber Orientalis.
American Styrax.....From Liquidamber Styraciflua.
Dragon's Blood.....From fruit of Dæmonorops draco.
Benzoin.....From Styrax Benzoin.

GUM-RESINS.

Gum-resins are milky exudations from plants, containing a gum soluble in water, a resin insoluble in water, but capable of being suspended in water, forming a milky mixture or emulsion. They also sometimes contain volatile oil. Those containing volatile oils are:

Myrrh.....From Balsamodendron Myrrha.
Olibanum.....From Boswellia Carterii.
Galbanum.....From Ferula galbaniflua.
Asafœtida.....From Ferula narthex and F. Scorodosma.
Ammoniac.....From Dorema ammoniacum.
Gamboge.....From Garcinia Hanburii.
Euphorbium....From Euphorbia resinifera.
Scammony.....From Convolvulus Scammonia.

FATTY OILS.

Some of these are of animal, others of vegetable origin. They impart a greasy stain to paper, which does not volatilize when heat is applied; are freely soluble in ether; cannot be volatilized by heat without chemical decomposition; give off irritating vapors at a temperature between 500° and 600° F.; are combustible, and, with a few exceptions, react with alkalies to form soaps. They are classified into:

I. Those which contain glycerin, and

II. Those which do not.

The former group is subdivided into Liquid and Solid fats.

The *Liquid* fats include drying and non-drying oils, and those of intermediate character.

The *Solid* fats include those which contain volatile oils, and those which do not.

The more important Drying Oils are: Flaxseed, Hemp, Nut and Poppy Seed oils. Characterized by their property of hardening on exposure to the air.

The more important Non-Drying Oils are: Olive, Almond, Colza, Benne, Mustard, Rape and Earth-nut oils of vegetable origin, and Neat's-foot, Lard and Bone oils of animal origin. These do not harden on exposure to the air.

The intermediate oils—that is, those which *thicken but do not solidify* on exposure to the air—constitute three groups:

1. *The Fish Oils*, including Cod, Sperm, Cod Liver, Porpoise, Hake, Shark, and some other oils.

2. The Cotton-Seed Oil Group, including Cotton-Seed, Beech-nut, Sesami, Sunflower, and some other oils, and

3. The Castor Oil Group, Castor and Croton Oils.

[*Soaps* are compounds of bases with fatty acids, and are divided into two kinds (1) Soluble Soaps, including potash and soda soaps, and (2) Insoluble Soaps, including those whose basic constituent is neither potash nor soda].

The Pharmacy of Organic Drugs.

The Solid Fats are those compounds of glycerin and fatty acids which are solid at ordinary temperatures. There are two groups (1) the odorous and (2) the odorless.

The first is subdivided into those whose odor is due to the presence of a volatile oil, and includes Expressed Oil of Nutmeg and Laurel Oil. The second includes Palm Oil, Cacao Butter, Cocoanut Oil and Butter. The principal non-odorous solid fats are Lard and Suet.

The second principal division of the fixed oils are those which do not contain glycerin, but instead a complex monatomic alcohol, and are called waxes The most important of these are: Bees', Chinese, Brazil, Myrtle, Spermaceti and Palm waxes.

Petroleum Ointment is a solid, or semi-solid, belonging to the paraffin series of compounds.

Emulsions are mixtures consisting of fats, oils, or oleoresins in a finely divided condition, and held in suspension in a solution of gum or other substance possessing emulsifying properties.

Milk, the milk juice of plants, and yelk of egg are examples of natural emulsions.

THE ORGANIC DRUGS.

The organic drugs embrace those obtained from the vegetable and animal kingdoms. These are divided into three classes:

I. Drugs destitute of active medicinal constituents.

II. Drugs possessing active medicinal constituents.

III. Unclassified drugs, and those of animal origin.

These were then each divided in eight distinct groups, as follows:

1. Drugs destitute of active medicinal constituents. Of this group the following are officinal:

Com. Name	Bot. Name.	Part Used.	Constituents
Almond, Sweet.	Amygdala communis var. dulcis.	Seed.	Fixed oil, mucilage, sugar.
Althæa.	Althæa officinalis.	Root.	Starch, mucilage, asparagin.
Cetraria.	Cetraria Islandica.	Plant.	Lichenin, cetraric acid.
Chondrus.	Chondrus Crispus.	Plant.	Mucilage, etc.
Cotton.	Gossypium herbaceum.	Hairs of seeds.	Cellulose.
Cydonium.	Cydonia vulgaris.	Seed.	Mucilage.
Elm.	Ulmus fulva.	Bark.	Mucilage.
Fig.	Ficus Carica.	Fruit.	Sugar, gum.
Flaxseed.	Linum usitatissimum.	Seed.	Mucilage, fixed oil.
Hæmat'xylon.	Hæmatoxylon Campechianum.	Heartwood.	Hæmatoxylin, tannin, resin.
Lycopod'm	Lycopodium clavatum.	Spores.	Fixed oil.
Malt.	Hordeum distichum.	Seed.	Diastase, sugar, starch.
Manna.	Fraxinus ornus.	Exudation.	Mannite, glucose, resin.
Prune.	Prunus domestica.	Fruit.	Sugar, pectin.
Sassafras Pith.	Sassafras officinalis.	Pith.	Mucilage.
Saunders, red.	Pterocarpus santalinus.	Wood.	Santalic acid, pterocarpin.
Triticum, Couchgrass	Triticum repens.	R'zome	Triticin, sugars

2. *Aromatic Drugs*, of which the following are officinal:

Com. Name	Bot. Name.	Part Used.	Constituents
Anise.	Pimpinella anisum.	Fruit.	Vol. oil, sugar, mucilage.
Buchu.	Barosma betulina.	Leaves.	Vol. oil, resin, bitter prin.
Calamus.	Acorus Calamus.	R'zome.	Vol. oil, resin, bitter prin'le.
Caraway.	Carum Carui.	Fruit.	Volatile oil 6%
Cardamom.	Elettaria Cardamomum.	Fruit.	Vol. oil, fixed oil, mucilage.
Cascarilla.	Croton Eluteria.	Bark.	Vol. oil, resin, cascarillin.
Chenopodium.	Chenopodium ambroseoides.	Fruit.	Volatile oil.
Cinnamon.	Cinnamomum Zeylanicum.	Bark.	Vol. oil, sugar, tannin.
Cloves.	Eugenia Caryophyllata.	Flowers unexpanded	Vol. oil, 18 %, caryophyllin, eugenin, resin
Coriander.	Coriandrum sativum.	Fruit.	Vol. & fix'd oil.
Cubeb.	Cubeba officinalis.	Fruit.	Vol. oil, 10%, resin, cubebin.
Eucalyptus	Eucalyptus globulus.	Leaves.	Vol. oil, 6%, resin, tannin.
Fennel.	Fœniculum vulgare.	Fruit.	Vol. oil, 4% fix'd oil, s'gar.
Gaultheria.	Gaultheria procumbens.	Leaves.	Vol. oil, ericolin, arbutin, urson.
Ginger.	Zingiber officinale.	R'zome.	Vol. oil, resin, gingerole.
Hedeoma.	Hedeoma pulegioides	Herb.	Volatile oil.
Illicium.	Illicium Anisatum.	Fruit.	Vol. oil, resin, fixed oil, tan.
Lavender.	Lavandula vera.	Flowers	Vol. oil, resin, tannin
Lemon peel	Citrus Limonium.	.....	Vol. oil, hesperidin.
Mace.	Myristica fragrans.	Aril.	Vol. oil, 8%, fix'd oil, resin
Magnolia.	Magnolia glauca.	Bark.	Vol. oil, resin, tannin, mag.
Marrubium	Marrubium vulgare.	Herb.	Vol. oil, resin, mar'ubin, tan.
Melissa.	Melissa officinalis.	Herb.	Vol. oil, tan'in, bitter prin'pl.
Nutmeg.	Myristica fragrans.	Seed.	Vol. oil, 5%, fixed oil, 25%.
Origanum.	Origanum vulgare.	Herb.	Vol. oil, resin, bitter prin'pl.
Orange fl'rs	Citrus Aurantium.	Flowers	Volatile oil.
Orange peel bitter.	Citrus vulgaris.	Rind of Fruit.	Vol'tile oil and hesperidin.
Orange peel sweet.	Citrus Aurantium.		
Pepper.	Piper nigrum.	Fruit.	Vol. oil, piperin, pung. res.
Pepp'rmint	Mentha piperita.	Herb.	Vol. oil, resin, pipmenthol.
Pimenta.	Eugenia Pimenta.	Fruit.	Vol. oil, resin, tannin.
Rose, pale.	Rosa centifolia.	Petals.	Vol. oil, sugar, tan. mucil'ge.
Rose, red.	Rosa Gallica.		
Rosemary.	Rosmarinus officinalis	Leaves.	Vol. oil, resin, tannin, etc.
Saffron.	Crocus sativus.	Stigma.	Vol. oil, crocin.
Salvia.	Salvia officinalis.	Leaves.	Vol. oil, resin, tannin.
Sambucus.	Sambucus Canadensis	Flowers	Vol. oil, resin, mucilage.
Sassafras.	Sassafras officinalis.	Root b'k	Vol. oil, 4%, tan. sas'afrid.
Scutellaria.	Scutellaria lateriflora.	Herb.	Vol. oil, bitter prin'ple, tan.
Spearmint.	Mentha viridis.	Herb.	Vol. oil, resin.
Sumbul.	Ferula Sumbul.	Root.	Vol. oil, angel, & valer. acids.
Tansy.	Tanacetum vulgare.	Herb.	Vol. oil, resin, tan. bit prin.
Valerian.	Valeriana officinalis.	R'zome.	Vol. oil, resin, valer., formic & acetic acids.
Vanilla.	Vanilla planifolia.	Fruit.	Vanillin, fixed oil, resin.

The Organic Drugs.

3. *Resinous Drugs*, the following are officinal :

Com. Name	Bot. Name.	Part Used.	Constituents
Absinthi'm	Artemisia absinthium	Herb.	Vol. oil, resin, tann., absinthin.
Arnica.	Arnica montana.	Flowr's, Root.	Vol. oil, resins, inulin, arnicin
Asclepias.	Asclepias tuberosa.	Root.	Bitter principle, resins, tannin, etc.
Aspidium.	Aspidium Filix mas.	R'zome.	Fixed oil, acid, filitan'ic acid
Azedarach.	Melia Azedarach.	Root b'k	Bitter resin.
Brayera.	Brayera anthelmintica.	Flowers	Kousin, resin, tannin.
Cannabis, American.	Cannabis sativa, var. Americana.	Herb.	Volatile oil and resins.
Cannabis, Indian.	Cannabis sativa, var. Indica.	Herb.	Vol. oil, resins, alkaloids.
Caulophyllum.	Caulophyllum thalictroides	R'zome.	Resins, saponin.
Ch'momile	Anthemis nobilis.	Herb.	Bitter principle, vol. oil.
Cimicifuga	Cimicifuga racemosa.	R'zome.	Acrid pr'ciple, resin, acid.
Cott'n Root	Gossypium herbaceum.	Root b'k	Resins, fixed oil, tannin.
Cypripedium.	Cypripedium pubescens.	R'zome.	Vol. oil, resins etc.
Frangula.	Rhamnus frangula.	Bark.	Bitter pr'ciple. resin, emodin frangulin.
Garlic.	Allium sativum.	Bulb.	Vol. oil, m'cg'e
Grindelia.	Grindela robusta.	Leaves & flo'rs	Bitter ext., vol oil, resin.
Guaiacum.	Guaiacum officinale.	Wood.	Extractive matter, resin.
Hamamelis	Hamamelis Virginica	Leaves.	Bitter extractive, tannin.
Inula.	Inula Helenium.	Root.	Extractive, helenin, inulin, acr. resin.
Iris.	Iris versicolor.	R'zome.	Vol. oil, acrid resin.
Jalap.	Exogonium purga.	Root.	Resins.
Juniper.	Juniperus communis.	Fruit.	Vol. oil, juniperin, resins, and sugar.
Kamala.	Mallotus Phillipinen.	Hairs.	R'sins, rotlerin
Lappa.	Lappa officinalis.	Root.	Inulin, extr't, muc'ge, resin
Lupulin.	Humulus lupulus.	Strobil's	Vol. oil, resin, lupam. acid.
Matico.	Artanthe elongata.	Leaves.	Vol. oil, resin, acid, tannin.
Matricaria.	Matricaria chamomilla.	Flowers	Vol. oil, ex. acid, anth'mid
Mezereum.	Daphne mezereum.	Bark.	R'sin, daphnin volatile prin.
Phytolacca Berry.	Phytolacca decandra.	Fruit.	Acrid pr'ciple, sugar, gum.
Phytolacca Root.	Phytolacca decandra.	Root.	Acrid pr'ciple, resin, tannin.
Podophyllum.	Podophyllum peltatum.	R'zome.	Resins.
Pulsatilla.	Anemone Pulsatilla.	Herb.	Volatile acrid principle.
Pumpkin.	Cucurbita Pepo.	Seeds.	Acrid resin, fixed oil.
Pyrethrum	Anacyclus Pyrethr'm	Root.	Bitter pr'ciple resin inulin.
Savine.	Juniperus Sabina.	Leafy tops.	Vol. oil, resin, tannin.
Serpentaria.	Aristolochia serpentaria.	R'zome.	Bitter pr'ciple, v. oil, tannin.
Stillingia.	Stillingia sylvatica.	Root.	Resin, fix'd oil tannin, starch
Thuja.	Thuja Occidentalis.	Tops.	Vol. oil, pinipicrin, thujin resin, tannin.
Xanthoxylum.	Xanthoxylum fraxineum.	Bark.	Bit'r prin., oil, resin, tannin.

4. *Astringent Drugs*, the following are officinal :

Com. Name	Bot. Name.	Part Used.	Constituents
Castanea.	Castanea vesca.	Leaves.	Tannin, mucilage, extractive, resin.
Catechu.	Acacia Catechu.	Wood.	Tannin, catechin.
Geranium.	Geranium maculatum	R'zome.	Tannin 15%.
Krameria.	Krameria triandra.	Root.	Tannin 10%.
Nutgall.	Quercus infectoria.	Excres.	Tannin 60%, gal. acid 30%
White Oak.	Quercus alba.	Bark.	Tannin 9%, resin, coloring matter.
Prinos.	Prinos verticillatus.	Bark.	Tannin, resin, bitter p'ciple.
Rubus.	Rubus villosus.	Ro't b'k	Tannin 10%
Rumex.	Rumex crispus.	Root.	Tannin, chrysophan, acid, mucilage.

5. *Refrigerant Drugs*, the following are officinal :

Com. Name	Bot. Name.	Part Used.	Constituents
Cassia Fistula.	Cassia fistula.	Fruit.	Acids, pectin, sugar, mucil.
Lemon-juice.	Citrus Limonium.	Fruit.	Citric acid 10% mal acid, gum
Raspberry.	Rubus Idaeus	Fruit.	Acids, vol. oil, pectin, glucos
Rhus Glabra.	Rhus glabra.	Fruit.	Acid, tannin, col'r'g matter.
Tamarind.	Tamarindus Indica.	Fruit.	Acids, sugar, pectin, tannin

6. *Reactionary Drugs*, officinal (see also Glucosidal).

Com. Name	Bot. Name.	Part Used.	Constituents
Bitter Almond.	Amygdala amara.	Seeds.	Fixed oil, mucilage, sugar, amygdalin, emulsin.
Wild Cherry.	Prunus Virginiana.	Bark.	Bitter principle, tannin, amygdalin, emulsin.
Black Mustard.	Sinapis nigra.	Seeds.	Fixed oil, myrosin, sinigrin
White Mustard.	Sinapis alba.	Seeds.	Fixed oil, myrosin, sinalbin

8. *Unclassified Drugs*, officinal :

Com. Name	Source.	Part Used.	Constituents
Cantharid's	Cantharis vesicatoria	Insect.	Cantharidin.
Charcoal.	Lignum.	.....	Carb'n, earthy matter.
Animal charcoal.	Carbo animalis.	.....	Carbon, phosphate, carbonate of lime.
Cochineal.	Coccus Cacti.	Femalc.	Carminic acid.
Ox Gall.	Bos Taurus.	Gall.	Bilirubin, cholesterin, glycocholic, tauroch'lic acids
Isinglass.	Acipenser Huso.	Bladder	Gelatin.
Musk.	Mochus moschiferus.	Secret'n	Cholesterin, fat, ammonia, albumen, etc.
Pepsin.	Sus Scrofa.	St'mach	
Pancreatin	Carnivoræ.	Pancreas	

The Organic Drugs—(Continued).

6. *Glucosidal Drugs*, the following are officinal :

Com. Name	Bot. Name.	Part Used.	Constituents
Alocs.	Aloes Socotrina.	Juice.	Aloin, resin, vol. oil.
Apocynum	Apocynum cannabinum.	Root.	Apocynin, tannin, apocynum, etc.
Araroba.	Andira araroba.	.....	Chrysarobin, resin, gum.
Bryonia.	Bryonia alba.	Root.	Bryonin.
Calendula.	Calendula officinalis.	Herb.	Calendulin, vol. oil, bitter principle.
Calumba.	Jateorrhiza calumba.	Root.	Calumbin, berberine, acid.
Dulcamara	Solanum dulcamara.	Branches.	Dulcamarin, resin.
Capsicum.	Capsicum fastigiatum	Fruit.	Capsaicin, resin vol. oil.
Chimaphila.	Chimaphila umbellata.	Leaves.	Chimaphilin, arbutin, ericolin, ursou, tannin, etc.
Chirata.	Ophelia chirata.	Herb.	Chiratin, acid.
Colocynth,	Citrullus colocynthis.	Fruit.	Colocynthin, resin, oil, etc.
Cornus,	Cornus Florlda.	Rootb'k	Cornin, tan'in, resin.
Digitalis,	Digitalis purpurea.	Leaves.	Digitalin, resin, digitoxin.
Ergot,	Claviceps purpurea.	Sclerotium.	Sclerotic acid, scleromucin, fixed oil.
Euonymus.	Euonymus atropurpureus.	Bark.	Euonymin, resin, asparagin.
Eupatorium.	Eupatorium perfoliatum.	Herb.	Eupatorin, vol. oil, resin.
Juglans,	Juglans cinerea.	Bark.	Nucin, tannin, fixed and volatile oil.
Glycyrrhiza.	Glycyrrhiza glabra.	Root.	Glycyrrhizin, sugar, glycyramarin, resin, asparagin.
Leptandra,	Leptandra Virginica.	R'zome.	Leptandrin, resin. saponin
Quillaia,	Quillaia saponaria.	Bark.	Saponin.
Quassia,	Quassia excelsa.	Wood.	Quassin, resin.
Rhubarb,	Rheum officinale.	Root.	Chrysophan, acid, tannin, erythoretin, emodin, phæorctin, aporetin.
Rhus tox,	Rhus Toxicodendron.	Leaves.	Acid, tannin.
Santonica,	Artemisia maritima.	Flower.	Santonin, 2%, vol. oil, 1%.
Salix,	Salix alba.	Bark.	Salicin, tannin
Sarsaparilla.	Smilax officinalis.	Root.	Parillin, resin.
Senega,	Polygala Senega.	Root.	Senegin, polygalin, fixed oil.
Senna,	Cassia acutifolia.	Leaves.	Cathartic acid, sennacrol, sennit.
Squill,	Urginea Scilla.	Bulb.	Scillipicrin, scillitoxin, scillin, etc.
Taraxacum	Taraxacum dens-leonis.	Root.	Inulin, taraxacin, resin, sugar.
Ustilago,	Ustilago Maydis.	Fungus.	Fixed oil, acid, cryst'lin principle.
Uva Ursi,	Arctostaphylos Uva-Ursi.	Leaves.	Tannin, arbutin, ericolin, ursone.
Viburnum,	Viburnum prunifolium.	Bark.	Viburnin, resin, acid, tan.
Viola Tricolor.	Viola tricolor.	Herb.	Resin, salycilic acid, bitter principle.

7. *Alkaloidal Drugs*, the following are officinal :

Com, Name	Bot. Name.	Part Used.	Constituents
Aconite Root,	Aconitum napellus.	Root.	Aconitine napeline, oil.
Belladonna Root,	Atropa belladonna.	Root.	Atropine, belladonnine, hyoscyamine
Belladonna Leaves,	" "	Leaves.	
Chelidon'm	Chelidonium majus.	Herb.	Chelidonine, sanguinarine, acid, etc.
Cinchona.	Cinchona calisaya.	Bark.	Quinine, quinidine, cinchonine, cinchonidine, acids.
Colchicum Root.	Colchicum autumnale	Root.	Colchicine, starch, etc.
Colchicum Seed.	Colchicum autumnale	Seed.	Colchicine oil, colchiceine.
Conium.	Conium maculatum.	Fruit.	Coninc, conhydrine, fixed oil, vol. oil.
Erythroxylon.	Erythroxylon Coca.	Leaves.	Cocaine, hygrine.
Gelsemium	Gelsemium sempervirens.	R'zome.	Gels'minc, vol. oil, acid, resin
Guarana.	Paullinia sorbilis.	Seeds.	Caffeinc, tannin, saponin, resin.
Hydrastis.	Hydrastis Canadensis	R'zome.	Berberine, hydrastine.
Hops.	Humulus Lupulus.	Str'biles	Tannin, vol. oil, resin, lupuline.
Hyoscyamus.	Hyoscyamus niger.	Leaves.	Hyoscyaminc, hyoscine, hyoscypicrin.
Ignatia.	Strychnos Ignatia.	Seed.	Strychnine, brucine.
Ipecac.	Cephælis Ipecacuanha.	Root.	Emetinc, resin ipecacuanhic acid.
Lobelia.	Lobelia inflata.	Leaves.	Lobeline, resin lobelacrin, acid.
Menispernum.	Menispernum Canadense.	R'zome.	Berberine, resin, menisper.
Nux Vomica.	Strychnos nux vomica.	Seeds.	Strychnine, brucine, loganine, acid.
Opium.	Papaver somniferum.	Juice.	Morphine, codeine, thebaine, narcotine, narceine pseudo-morphine, etc.
Pareira.	Chondodendron tomentosum.	Root.	Pelosine, resin
Physostigma.	Physostigma venenosum.	Seed.	Phys'stigmi'e, calabarine, physosterin.
Pilocarpus.	Pilocarpus pennatifolius.	Leaves.	Philocarpine, volatile oil.
Pomegranate.	Punica Granatum.	Rootb'k	Pelleticrine, punicine, tan.
Sanguinaria.	Sanguinaria Canadensis.	R'zome.	Sanguinarine, resins.
Scoparius.	Sarothamnus Scoparius.	Tops.	Scoparin, tan. spart. vol. oil.
Spigelia.	Spigelia Marilandica.	R'zome.	Alkal. pr'ciple, vol. oil, resin.
Staphisagria.	Delphinium Staphisagria.	Seed.	Delphinine, oil, delphinoidine, delphis.
Stramon'm Leaves.	Datura Stramonium.	Leaves.	Atropine, hyoscyamine.
Stramon'm Secd.	Datura Stramonium.	Seed.	Atropine, oil, hyscyamine.
Tobacco.	Nicotiana Tabacum.	Leaves.	Nicotine, nicotianin, resin.
Veratrum Viride.	Veratrum viride.	R'zome.	Jervine, pseudo-jervine, rubi-jervine, veratroidine.

The Inorganic Compounds.

THE INORGANIC COMPOUNDS.

The Inorganic Acids resemble the organic acids in the fact of being built up on the type of the water-molecule, with the exception of the haloid acids, and in many physical properties, but differ to the extent of containing an inorganic negative radical, and indicating their basicity by the number of hydrogen atoms. Their compounds are more stable, and not so complex in composition.

The following are officinal :

		Strength %;	Sp. Gr.
Acid Arsenious	Arsenious Anhydride, As_2O_3.		
Acid Boric.	Or Boric Acid.		
Acid Chromic.	Chromic Anhydride, CrO_3.		
Acid Hydrobromic		10	1.077
Acid Hydrochloric		31.9	1.19
Acid Hydrocyanic		2.	
Acid Nitric		69.4	1.42
Acid Nitrohydrochloric			
Acid Phosphoric		50.	1.347
Acid Sulphuric		96.	1.84
Acid Sulphurous		3.5	1.022

The Metallic Elements and their compounds are divided for pharmaceutical convenience and to facilitate comparisons into Groups, closely resembling those of Inorganic Chemistry.

GROUP I.

The Alkali Metals include Potassium, Sodium, Lithium and Ammonium.

Ammonium is placed also in this group, as the substance ammonia in its chemical combinations acts the part of a compound basilous radical.

	Pharm. Uses and Preparations.
Ammonium—	
Acetate	Solution.
Benzoate.	
Bromide	Elixir.
Carbonate	Aromatic Spts.; Solution; acetate; Iron and ammonium tartrate.
Chloride	Troches.
Iodide	Liniment.
Nitrate	Nitrous Oxide.
Phosphate.	
Sulphate.	
Valerate	Elixir.
Potassium—	
Caustic	Solution ; potassa with lime.
Sulphurated.	
Acetate.	
Bicarbonate	Mixture citrate of potassium ; sol. citrate magnesium ; solution of potassa ; solut'n arsenite of potassium; sol. citrate potassium.
Bichromate.	
Bitartrate	Tartrate iron and potassium; comp. powder of jalap.
Bromide	Elixirs.
Carbonate	Alkaline sulphur ointment; compound mixture of iron; sulphurated potas.; syrup of rhubarb.
Chlorate	Troches.
Citrate.	
Cyanide.	
Ferrocyanide	Diluted hydrocyanic acid.
Hypophosphite	Syrup of hypophosphites.
Iodide	Ointment ; com. solution of iodine ; iodine ointment ; red iodide of mercury.
Nitrate	Paper ; diluted nitrate of silver.
Permanganate	Test solution ; pills ; disinfectant.
Sulphate.	
Sulphite.	
Tartrate.	
Tartrate and Sodium, Com. effervescing powder.	

	Pharm. Uses and Preparations.
Sodium—	
Soda ; Hydrate	Solution.
Acetate.	
Arseniate	Solution.
Benzoate.	
Bicarbonate	Troches ; compound effervescing powder ; granulated cit. magnesium ; mixture rhubarb and soda ; sacch. carb. iron.
Bicarbonate (impure).	
Bisulphite.	
Borate,	
Bromide.	
Carbonate	Dried carbonate ; comp. pills of iron ; hydrate of aluminium ; mass of carbonate of iron; purified chloroform ; solution of chlorinated soda; solutionsoda.
Chlorate.	
Chloride.	
Hyposulphite	Syrup of Hyposulphites.
Iodide.	
Nitrate.	
Phosphate	Phosphate of Iron.
Salicylate.	
Santoninate	Troches.
Sulphate.	
Sulphite.	
Sulphocarbolate.	
Lithium—	
Benzoate, Bromide, Carbonate, Citrate, Salicylate,	Variously in Elixirs and in effervescing salts.

GROUP II.

The Alkaline Earths include Magnesium, Strontium, Calcium and Barium.

Magnesium was always classified in this group, until recently. We have retained it here, as on pharmaceutical considerations, its compounds have many properties in common, both physical and chemical, with this group.

Strontium and Barium furnish no officinal compounds, but some are well known in pharmacy as the nitrate and chloride of strontium in pyrotechnics ; barium chloride being used as a test solution of the Pharmacopœia.

	Pharm. Uses and Preparations.
Magnesium—	
Magnesia	Troches : hydrated oxide of iron with magnesia ; comp. powder of rhubarb ; mass of copaiba.
Magnesia (heavy)	
Carbonate	Solution cit. of magnesium; mixture of magnesia and asafœtida ; granulated cit. of magnesium.
Sulphate	Compound infusion senna.
Sulphite.	
Calcium—	
Lime (Hydrate)	Chlorinated; solution; syrup; potassa with lime; sulphurated lime ; purified chloroform; sol. of potassa; sol. of soda; precip. sulphur ; liniment.
Bromide.	
Carbonate (Precip).	Compound powder of morphine.
Chloride	
Hypophosphite	Syrup Hypophosphites.
Phosphate (Precip).	Syrup lactophosphate of calcium ; antimonial powder; syrup of orange ; comp. syrup of squills.

The Inorganic Compounds.

GROUP III.

The Aluminium Group contains Aluminium, Zinc, Manganese, and Cerium.

Of this, Zinc furnishes the largest and most important class of compounds, Cerium furnishing but one, the oxalate; Manganese is sometimes placed in the Iron Group because, like them, it forms basic oxides. They are grouped together more from a similarity in physical than chemical properties.

	Pharm. Uses and Preparations.
Aluminium—	
Alum	Dried alum; hydrate of alumin.
Hydrate.	
Sulphate.	
Zinc—	
Metallic	Solution of chloride of zinc.
Acetate.	
Bromide.	
Carbonate (Precip.)	Solution of chloride of zinc.
Chloride	Solution.
Iodide.	
Oxide	Ointment.
Phosphide.	
Sulphate.	
Valerate.	
Manganese—	
Dioxide	Chlorine water.
Sulphate.	
Cerium—	
Oxalate.	

GROUP IV.

The Iron Group contains Iron, Chromium, Cobalt, and Nickel, and are analogous in many chemical and physical properties.

Of these Iron only is of interest, and furnishes a variety of important compounds. Chromium is of interest, but in most of the pharmaceutical substances into which it enters it acts the part of an acid, as in chromic acid and Potassium Bichromate.

	Pharm. Uses and Preparations.
Iron—	
Metallic	Chloride of iron; saccharated iodide of iron; solution chloride of iron; syrup bromide of iron; syrup iodide of iron.
Reduced	Pills iodide of iron.
Acetate	Solution acetate of iron; tincture acetate of iron.
Chloride	Solution; tincture.
Citrate	Citrate iron and quinine; phosphate of iron; pyrophosphate of iron; solution citrate of iron.
Citrate (ammoniated)	Citrate of iron and strychnine; solution citrate, of iron and quinine; wine of citrate of iron; bitter wine.
Citrate and Quinine.	
Hypophosphite.	
Iodide	Pills; syrup; saccharated.
Lactate	Syrup hypophosphites with iron.
Oxalate.	
Hydrate	Iron plaster; troches of iron; hydrated oxide with magnesia.
Phosphate	Syrup of phosphates of iron, quinine and strychnine.
Pyrophosphate	Elixirs; syrups.
Sulphate	Dried and precip. sulphate of iron; mass of carbonate of iron; compound iron mixture; compound pills; saccharated carb. of iron; solution subsulphate of iron; solution tersulphate of iron.
Sulphate (dried)	Pills of aloes and iron.
Sulphate and Ammonium.	
Tartrate and Ammonium.	
Tartrate and Potassium.	
Valerate.	

GROUP V.

The Lead Group consists of Lead, Copper, Silver, Mercury, and Cadmium.

All of these, with the exception of Cadmium, furnish several important compounds. The compounds of mercury are of great pharmaceutical importance; they are all closely allied chemically, but differ greatly in their physical properties.

	Pharm. Uses and Prepartions.
Lead—	
Acetate	Solution sub. acetate.
Carbonate	Ointment; sol. gutta-percha.
Iodide	Ointment.
Nitrate.	
Oxide	Lead plaster; solution of subacetate of lead.
Copper—	
Acetate	Tincture.
Sulphate	Test solution.
Silver—	
Cyanide.	
Iodide.	
Nitrate	Diluted nitrate of silver; moulded nitrate of silver.
Mercury—	
Metallic	Mass; mercury with chalk; ointment; plaster; ointment of nitrate of mercury; ammoniac plaster with mercury; green iodide of mercury; yellow subsulphate of mercury.
Ammoniated	Ointment.
Chloride (corrosive)	Red iodide of mercury; yellow oxide of mercury; ammoniated mercury.
Chloride (mild)	Comp. pills of antimony; comp. cathartic pills.
Cyanide.	
Iodide (red)	Solution of iodide arsenic and mercury.
Iodide (green).	
Oxide (yellow)	Oleate; ointment.
Oxide (red)	Ointment; solution nit. mercury.
Sulphate (yellow).	
Sulphide (red).	

GROUP VI.

The Arsenic Group consists of Arsenic, Antimony, Tin, Gold, and Platinum.

Tin is the only unofficinal member, but furnishes the well-known chloride, the solution of which is frequently used. They present several analogies. Arsenic is sometimes classed as a non-metallic element; in luster and specific gravity it closely resembles the metals, and is therefore slassed with them.

Gold and Platinum both require Nitro-hydrochloric acid for solution, the platinic and auric chlorides being used as officinal test solutions. Molybdate of soda is used as a test reagent.

	Pharm. Uses and Preparations.
Antimony—	
Potassium tartrate	Compound syrup squills; wine.
Oxide	Antimonial powder.
Sulphide	Purified sulphide.
Sulphide (purified)	Sulphurated antimony.
Sulphurate	Compound pills.
Arsenic—	
Iodide	Solution iodide arsenic and mercury.
Bismuth—	
Citrate	Citrate bismuth and ammonium.
Subcarbonate.	
Subnitras	Citrate of bismuth.

Examination Questions.---Term I.

Including Questions on Lecture XI.

1. Define the term Pharmacy, and state the distinction between *theoretical* and *practical* pharmacy.
2. What is a Pharmacopœia, and what is its *principal* object?
3. What is *Weight?* What Systems of Weight are in common use in Pharmacy?
4. What is the difference between a Troy and an Avoirdupois *Ounce?* Between a Troy and an Avoirdupois *grain?*
5. Give the weight of a *minim* of Water; of one *fluid ounce* of Water.
6. What is the difference in *weight* between a U. S. Pint and an Avoirdupois Pound of Water?
7. How are the *standard units* of Length, Weight and Capacity of the Metric System obtained?
8. Give the *equivalent* of one Minim, one Fluid Ounce, one Pint; also one Grain, one Ounce and one Pound (Troy), in Metric Measure and Weights.
9. State the *rule* for determining the Specific Gravity of Solids and Liquids.
10. How much Drug in *grains* would be required to make one Pint of a 15 per cent. Tincture (Menstruum Alcohol)?
11. How can you determine the *measure* of a Liquid whose weight you know?
12. Convert 20°C and 20°R., respectively, to F. degrees.
13. Define *Heat*, and what constitutes the *real* difference between a *cold* and a *hot* body.
14. How much Ice is necessary to reduce one pound of Boiling Water to 60°F?
15. What *changes* occur in the drying of Drugs?
16. What are the advantages of using a Drug in the *powdered* form?
17. Why are drugs, as a rule, used in *coarse* powder for Aqueous and *fine* for Alcoholic, Menstrua?
18. What is the *object* of using Water, Oil or Sand-Baths in various processes?
19. Define Distillation.
20. Why does the *solution* of a Solid cause a *decrease* of Temperature, as a rule?
21. Define *Diffusion*, *Capillarity* and *Solution*; and to what are the phenomena attributed? Define *Dialysis* and its object.
22. Mention the several processes of *Extraction*, and the common constituents of drugs that are *rejected*, as a rule.
23. Define *Percolation*, and state why some drugs are macerated *before* being percolated.
24. How many different Classes of Galenical Preparations does the U. S. P. include? Name them.
25. Which is the *best* preparation of Cinchona,—the Decoction or Infusion,—and why?
26. How much *Hydrate of Iron* can be prepared from two fluid ounces Solution Tersulphate of Iron?
27. What *Officinal Preparations* could be prepared from Tincture Nux Vomica?
28. How *much* of each preparation of Nux Vomica could be prepared from *one ounce of Extract?*
29. Give the *quantity* of *crude drug* represented by *one grain* of each of the following *Extracts*, and the *dose* of each Extract, based upon *one grain* as the dose of each Drug: Aconite, Belladonna, Digitalis, Hyoscyamus, Nux Vomica, Opium.
30. Give the *quantity* of *Abstract* that could be made from 480 grains of each of the *above* Drugs.
31. Define briefly the *structure* of the Acid Molecule.
32. Mention the *officinal* Organic Acids. To what Officinal "acids" is the term *Acid* erroneously applied?
33. How is Lactic Acid prepared? Mention common impurities, and how determined.
34. Write a concise description of *Starch*, from what you know of it.
35. Write an explicit and concise account of *Alcoholic* Fermentation. What *properties* characterize the Alcohols?
36. Mention the principal Carbohydrates. How do they agree in *chemical structure* and how do they *differ* from Hydrocarbons?
37. How do Volatile Oils differ from Fixed Oils? Mention the different classes of each.
38. Describe each of the following briefly: Resin, Oleoresin, Gum-resin, and Balsam, and state by what *physical* tests they may be distinguished.
39. How are the Officinal *Resins* prepared?
40. What is Lead Plaster, *chemically*? What *reaction* occurs in its preparation?
41. Mention the Officinal Preparations in which the process of *Saponification* occurs.
42. Define briefly an *Emulsion*, and state the *proportion* of the three necessary ingredients.
43. Mention the various Classes into which the *Organic Drugs* may be divided.
44. What *bearing* has a knowledge of their constituents in the *Extraction* of drugs?
45. Mention the different Classes of *Proximate Principles* contained in plants.
46. State the *general characteristics* of each Class.
47. Mention *specific tests* for Quinine, Morphine and Strychnine.
48. Mention the three Officinal *inorganic* Classes of Compounds.
49. How do *inorganic* Acids differ from Organic?
50. Mention the Officinal *inorganic* Acids. What *properties* serve to establish their *identity* and *purity?*
51. Mention *common impurities* in Commercial Acids, and account for their presence.
52. By what *means* does the U. S. P. determine the *strength* of Acids?
53. What is meant by a *Base*, and what chemical bases are Officinal?
54. What is the *product* of the union of an Acid and a Base termed? Mention the different Classes of such compounds that are Officinal.
55. What *Elements* form *two* series of Officinal Compounds?
56. Mention the *general* means by which the *Identity* and *Purity* of Officinal Chemical Compounds are determined in U. S. P., 1880.

(*Continued on next page.*)

Term Examination—(Continued).

Questions on Dispensing.

In the following state (1), in the case of liquids, whether or not clear solutions can be obtained.
(2) The method of Dispensing; opinion as to compatibility and safety in administration.
(4) Comment upon any other feature as worthy of remark.

57. *Ferri et Potas, tartratis* ℥ ii.
Tinct. cinchonae comp. ℥ iv.
M. et ft. sol.

58. *Potassii bromidi*..... ℥ ii.
Chloralis..... ℥ ii.
Tincturae Hyoscyam... ℥ iv.
Elixir.....*q. s.* ℥ ii.
M. et ft. sol.
Sig. One teaspoonful.

59. *Potas. permanganatis*.. ℥ iii.
Aquae distillatae,
Syrupi, *a.a*..... ℥ iv.
Glycerini..... ℥ i.
M. et ft. sol.

60. *Asafoetidae*..... ℥ i.
Aquae cinnamomi, *q.s.* ℥ viii.
Fiat emulsio.

61. *Aquae Ammoniae*,
Aetheris, *a.a*..... ℥ iii.
Olei Terebinthinae,
Olei Caryophyllae, *a.a*. ℥ i.
Olei Olivae..... ℥ iss.
Chloroformi..... ℥ ii.
Misce. Sig. Externally.

62. *Hydrargyri Chloridi*
Corrosive.....*gr. ii.*
Tincturae Guaiaci ammoniati..... ℥ ii.
Syrupi Aurantii cort. ℥ i.
M. et ft. sol.
Sig. One teaspoonful.

63. *Acidi Gallici*.....*gr. xx.*
Tincturae Catechu....*m. xc.*
Aquae Menthae piperitae.....*q.s.* ℥ ii.
M. et ft. sol.
Sig. One teaspoonful.

64. *Tinct. Ferri Chloridi*... ℥ ii.
Spiriti Aetheris nitrosi ℥ ii.
Mucilaginis Acaciae... ℥ i.
Syrupi.....*q.s.* ℥ iii.
M. et ft. sol.
Sig. One teaspoonful.

65. *Copaibae*..... ℥ vi.
Spiriti Aetheris nitrosi ℥ i.
Extracti Glycyrrhizae fluidi..... ℥ i.
Fiat Emulsio.....*q.s.* ℥ iv.

66. *Morphinae sulphatis*..*gr. ii.*
Sodii bicarbonatis..... ℥ i.
Aquae Menthae pip. q.s. ℥ iv.
M. et ft. sol.
Sig. One teaspoonful.

67. *Acidi Tannici*.....*gr. xx.*
Extracti Belladonnae, *gr. x.*
Extracti Ergotae.....*gr. xc.*
Olei Theobromae, *q. s.*
Fiant suppositoriae No. xii.

68. *Atropinae sulphatis*, *mg. 1.5*
Aquae.....*Gram 30.0*
M. D. S. As directed.

69. *Acidi Salycilici*..... *5.*
Make an emulsion representing 5 grains salicylic acid in each dessertspoonful.

70. *Phosphori*..... *0.1*
Abstr. Nucis Vomicae.... *1.0*
Fiant pilulae No. x.

71. *Ferri sulphatis*..... ℥ ii.
Potassii Carbonatis, *gr. lxx.*
Sacchari.....*gr. xxiv.*
Misce, fiat massa et in pil. No. xlviii divid.

72. *Potasii permanganatis*, *10.*
Fiant pilulae No. C.

☞ Answers to these questions should be received *within* thirty days after receipt. Ratings for the Term will be promptly forwarded only to such students who comply with the requirements; to those in arrears, only upon extension being granted by

The Director.

To the Student.

With this lecture the Term in Pharmacy is completed, and it may be assumed that some who have answered the questions upon all the lectures, and obtained a satisfactory rating in the Term just closed, may desire a short vacation before entering upon Term II.

For these we shall gladly extend the time, so that they may study with renewed vigor, and with that assurance of eventual success, which comes from an "easy mind and strong body," thus preparing themselves for the more scientific branches of pharmacy, namely: Botany, Materia Medica and Chemistry,

In this connection the student should remember that these sciences are the corner-stones of pharmacy; that upon these the whole science and art of pharmacy is based. In order, therefore, to obtain such information as will constitute education, it is essential that these various branches be assiduously studied, and their fundamental principles carefully learned. As in life the really educated person may be easily distinguished by his relative capability to grasp facts, because of his knowledge of the principles involved, so in pharmacy, the constantly changing scene of activity, with its ever-increasing productions, is best appreciated and understood by those who can follow it through all the gradations and mutations of modern science.

But not alone to those engaged in pharmacy may the study of botany and chemistry be regarded as the very fountain of all knowledge. To these every grand achievement of human energy and thought are due, from the steam engine of Watt to the marvelous researches of modern bacteriologists.

Should you desire to continue, without interruption, we shall be pleased, upon receipt of advice, to enter you in the class beginning the Second Term at the beginning of each month. If desirable, Chemistry may be taken before that of Botany and Materia Medica.

In order to further improve the Institute system, we desire your replies to the following questions. The answers should be written on separate sheets of paper with date, name and address of sender:

1. Is the time allotted to the study of each lecture and to the answering the questions (fifteen days) such as may be spared from duties in the average drugstore?

2. Have the questions, as a rule, been of a character which, while involving the principles to be learned, were yet so constructed that the answers were not easily obtained by simply referring to the lectures or text-books?

3. To what extent have they covered the subjects treated in the lectures, and do you consider them difficult?

4. Could this number be advantageously increased?

5. Do you suggest any other change in the feature of questions with each lecture?

6. Have you found it necessary to consult many reference books in studying? If so, from which have you derived the most benefit?

7. Would it be advisable to make more frequent reference in the lectures to standard works?

8. Would it be advisable to begin with the term in Botany and Chemistry, instead of Pharmacy?

9. The subjects treated under Pharmacy being based upon Botany, Chemistry and Physics, should the study of the latter *precede* that of Pharmacy, so that Pharmacy is better understood?

10. Would the necessary theoretical study of Chemistry and Botany prove uninteresting as compared with Pharmacy, and tend to diminish the enthusiasm of beginners with the first term?

11. Would it be as practical for study, and as advantageous to mail the lectures semi-monthly, but *alternately*, viz: Chemistry, Botany, Pharmacy?

General Question, answer to which is desired for the information of the director, to be written on separate sheet with the name and address.

In order to obtain reliable data regarding the extent the Metric system is used in prescription writing throughout the country, please ascertain the number of prescriptions written in the Metric system in 1,000, taken *consecutively* from your file, and transmit the same at your convenience.

Very truly,

THE DIRECTOR,

C. S. Hallberg, Ph. G. *Director.* G. P. Engelhard & Co., *Publishers.*

National Institute of Pharmacy

INCORPORATED A.D. 1885.

CHICAGO, U.S.A.

Department of Examinations.

358 ~~69~~ Dearborn Street, Dec. 19th 1891.

C. F. Carpenter, East Hampton, Conn.

Dear Sir;

We take pleasure in transmitting the percentage obtained by you in the Examination on the Lectures on Pharmacy.

In order to arrive at the real standing attained by you throughout the Term, we have computed the average percentage of Lectures I to X, inclusive, and that of the Examination (Lecture XI and XII); these, added together and divided by two, constituting the final average for the Term.

We thus obtain not merely an idea of the student's ability to answer the questions on a few of the examinations, but a very comprehensive estimate of his knowledge on all subjects included in the Term, and the average may therefore be regarded as a fair criterion upon which to judge of his attainments.

It would be obviously impossible to send corrections on the Term Examination, and since the questions to a great extent involve the subjects previously treated, neither should it be required or deemed necessary.

We should be pleased to be informed of the receipt of the rating herewith, and also whether or not you desire to join the class beginning Term II Jan 1st 1892

Very truly,

DIRECTOR.

May 15th 1891 Class. 627

Lecture	I,	95
"	II,	85
"	III,	85
"	IV,	90
"	V,	85
"	VI,	80
"	VII,	90
"	VIII,	95
"	IX,	90
"	X,	85

Total for Lectures I—X,	880
Average for Lectures (divided by 10),	88.00
Term Examination,	80
Total,	168
Term Average (dividing total by 2),	84.00

which is very good-

A. E. Hiss, Ph.

Director

Examiner

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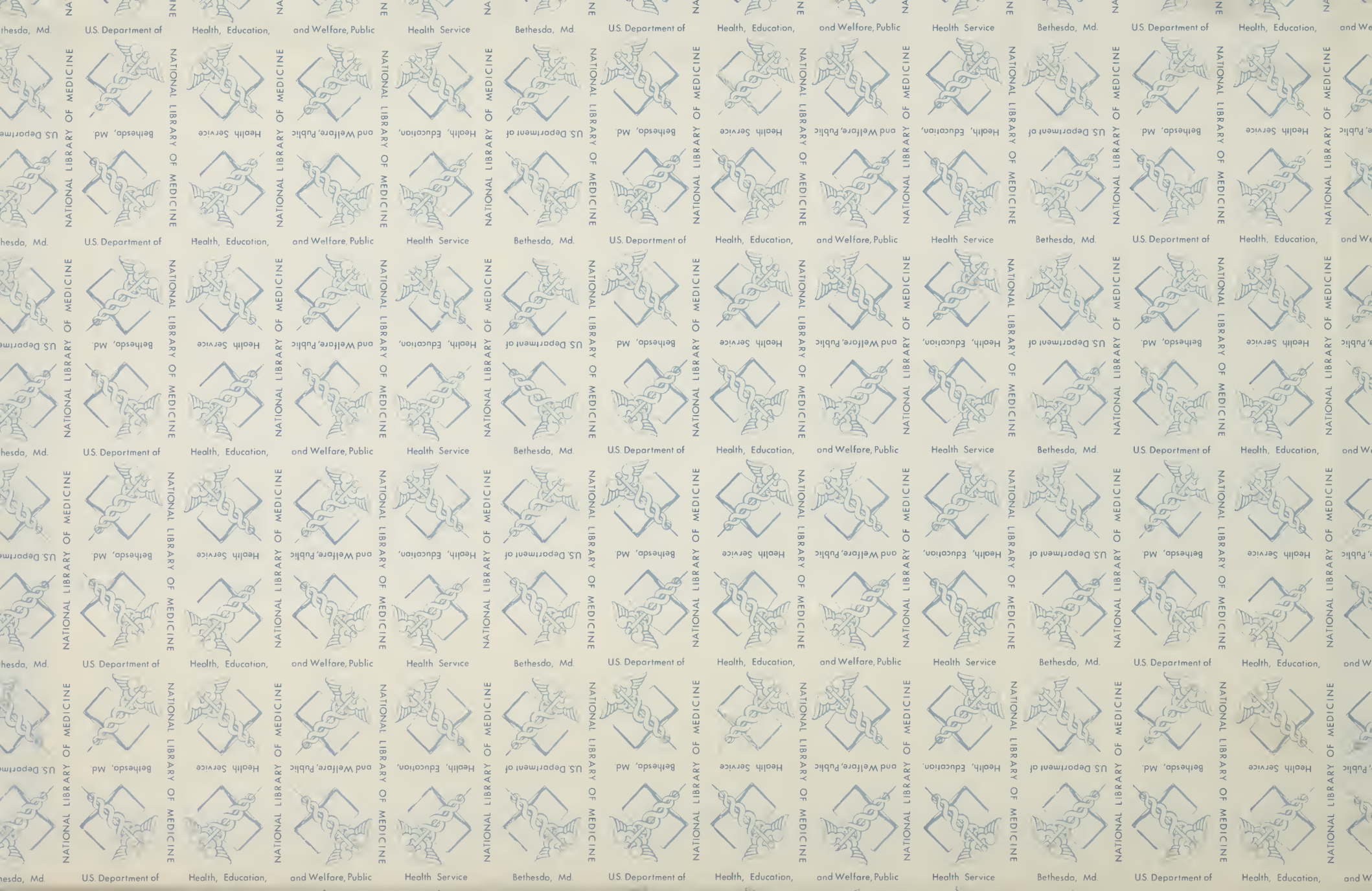
Bethesda, Md.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